REMEDIAL ACTION WORKPLAN

ABC Barrel Company Site - 308 to 322 North Front Street
Block 62, Lots 38 and 45
City of Camden, Camden County, New Jersey
NJDEP SRP PI#006594

Prepared for:

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CERTIFICATIONS
N.J.A.C. 7:26-1.2 et. seq.

Any person making a submission to the Department required by this chapter and pursuant to N.J.A.C. 7:26E, shall include the following signature and notarized certification, for each technical submittal. Additionally, the certification shall indicate the case name and address, case number, type of documents submitted. e.g. Remedial Action Report, for each technical submittal.

TYPE OF DOCUMENT **Remedial Action Workplan**

CASE NAME **ABC Barrel Company Site**
CASE ADDRESS **308-322 North Front Street**
City of Camden, Camden County, New Jersey

CASE NUMBER **SRP PI#006594**

The following certification shall be signed by:

I. For a corporation by a principal executive officer of at least the level of vice president:
2. For a partnership or sole proprietorship, by a general partner of the proprietor, respectively, or:
3. For a municipality. State, Federal or other public agency, by either a principal executive officer or ranking elected official.
4. For persons other than 1 through 3 above, by the person with legal responsibility for the site.

"I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information. to the best of my knowledge, I believe that the submitted information is true, accurate and complete. I am aware that there are significant civil penalties for knowingly submitting else, inaccurate or incomplete information and that I am committing a crime of the. fourth degree if I make a written false statement that I do not believe to be true: I am also aware that if I knowingly direct or authorize the violation of any statute, I am personally liable for the penalties."

PRINTED NAME Saundra Ross Johnson **TITLE** Executive Director

SIGNATURE [signature] **DATE** 11/14/11

NOTARY SIGNATURE [signature] **DATE** 11/14/11

DELORES LITTLE
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires 2/10/2016

EXECUTIVE SUMMARY

This document presents the Remedial Action Workplan (RAW) for the ABC Barrel Company Site (a.k.a. AABCO Steel Drum Site) located at 308-322 North Front Street, in the City of Camden, Camden County, New Jersey. The ABC Barrel Company Site (the "Site") is currently owned by the Camden Redevelopment Agency (CRA). The regional location of the Site is shown on the U.S. Geological Survey (USGS) Topographic Map in **Figure 1**. An Aerial Photograph of the Site showing the site boundaries and current Tax Map Lot and Block Lines is presented as **Figure 2**.

The CRA, acting in its capacity as implementer of the Downtown Redevelopment Plan and as manager of the Camden Brownfield Program, is working with the Cooper Grant Neighborhood Association (CGNA) to remediate and redevelop the Site. The Site is planned for redevelopment as Cooper Grant Homes Phase II, which will consist of ten (10) residential townhomes, parking areas, access roadways, and a public park area. Remediation of the Site is partially being funded by a United States Environmental Protection Agency (USEPA) Brownfield Cleanup Grant.

The ABC Barrel Company Site formerly consisted entirely of Block 62 Lots 38 and 45, however, in 2010, the block and lot lines were further subdivided to accommodate the proposed development. The existing block and lot lines for the proposed residential dwelling are as follows: 1) Block 62.01 Lots 1 through 4; 2) Block 62 Lots 17 through 20; and 3) Block 62.02 Lots 25 and 26. The remainder of the property (approximately 0.65 acres) consists of Block 65 Lots 38 and 45 [which will be used as a public park (Harris Memorial Park)] and the surrounding public Right-of-Way (ROW) including access roadways Harris Way and Centennial Avenue. As shown in **Figure 4**, it is planned to modify the existing residential lot and block lines so that the parking areas behind the buildings are located entirely within the public use/ROW areas. This will result in a significant cost savings for the project by minimizing the excavation volumes and reducing the costs for off-site disposal of regulated waste.

For the residential parcels, an unrestricted use remedial action strategy has been selected that consists of removal and disposal of all historic fill materials (down to approximately 12 feet) and replacement with clean fill materials. For the public use areas, a restricted use strategy has been selected that includes limited removal of historic fill materials and placement of an engineering cap (2 feet in thickness) in conjunction with obtaining a Soil Remedial Action Permit and filing a Deed Notice (Institutional Controls) for the contaminated soils remaining on-site. The proposed excavation and engineering cap for the public use areas is not proposed for the Centennial Avenue roadway which is an existing paved surface that functions as an engineering cap.

CRA has contracted Dresdner Robin for the development/preparation of this RAW for the remediation of impacted soil in two areas of concern (AOCs) remaining at the Site and for the removal of historic fill materials in support of the site development as described above.

The contaminants of concern/areas of concern identified for soil requiring further actions under the NJDEP Site Remediation Program (SRP) are tetrachloroethene (PCE) in a former trench excavation area adjacent to the southwest side of Building No. 1 (AOC-G); and potentially petroleum related contamination in a former No. 2 Fuel Oil UST excavation area to the east of Building No. 2 (**Figure 3**). This delineation and removal of the contaminated soil associated with these AOCs will be completed prior to removal of historic fill materials at the Site. Historic fill at the Site has been found to be contaminated with polynuclear aromatic hydrocarbon (PAH) compounds and metals at concentrations that exceed the New Jersey Residential and Non-Residential Soil Remediation Standards. Construction of the residential dwellings and development of the public use/ROW areas is being planned during Phase II of the project following completion of the site remediation as detailed in this RAW.

This RAW has been prepared in accordance with the NJDEP's *Technical Requirements for Site Remediation* as detailed in the New Jersey Administrative Code (N.J.A.C. 7:26E-6.2. To comply with the applicable USEPA and NJDEP regulations and guidance, this RAW incorporates the following three (3) project plans: 1) a Site-Specific Health and Safety Plan (HASP); 2) A Quality Assurance Project Plan (QAPP); and 3) a Sampling, Analysis, and Monitoring Plan (SAMP). For the ABC Barrel Company Site project, CRA has been authorized by EPA to use their Region 2 Generic Brownfield's Quality Assurance Project Plan (**Appendix E**) to fulfill the requirements for a QAPP.

As required by EPA, ABC Barrel Company Site SAMP was prepared using USEPA's Generic Brownfield's QAPP Boilerplate (**Appendix D**). The scope of work as detailed in the SAMP includes: 1) characterization/delineation sampling as required under the NJDEP SRP for AOC-G and AOC-B2; and 2) in-situ waste classification sampling for characterization of historic fill materials prior to removal from the site.

In support of the site development, CRA with assistance from Dresdner Robin is currently preparing a bid package with Technical Specifications (Specifications) and Environmental Plans for the project that detail the contractor's requirements for the site remediation. Contaminated material management procedures have been developed based upon the Specifications that were designed to be protective of human health and the environment. The specific contaminated material handling and management procedures described in this RAW include:

- Contaminated soil excavation, loading, stockpiling, transportation, and disposal of regulated waste; and
- Contaminated liquids dewatering, treatment, and on-site recharge
- Clean fill backfilling/engineering cap placement

Based upon historic site data, it is most likely that the excavated contaminated soil/historic fill materials will be classified as 'non-hazardous' regulated waste, however, final determination will be made by the selected receiving facility based upon the results of the waste characterization sampling proposed in this RAW. It should be noted that for the purposes of the RAW and for development of the SAMP, sampling requirements and frequency for historic fill materials were used from the Clean Earth of Philadelphia facility.

During construction dewatering activities, surface water runoff or seepage into the excavation in contact with historic fill materials will have to be managed as regulated waste. To accomplish this, treatment (sediment removal and oil-water separation) and discharge to an on-site infiltration basin will be the most practical strategy. Therefore, this RAW requests that NJDEP issue a New Jersey Pollution Discharge Elimination System (NJPDES) Permit-by-Rule Discharge Authorization for the project to allow on-site recharge of groundwater during construction dewatering activities. The information necessary to support issuance of the Permit-by Rule is provided in Section 5.3.4 of this RAW.

Volumes of historic fill to be removed from the residential parcels was estimated using an average depth of twelve (12) feet below existing grade based upon the results of historic fill characterization borings conducted at the Site by Remington & Vernick in 2001. Taking into consideration the proposed grade elevations as shown on the grading plan provided by Consulting Engineer Services (CES), the depth of excavation for historic fill within the public use/ROW area was estimated at +/- 1-foot to accommodate placement of a 2-foot thick engineering cap. The area of each residential parcel and the remaining public use/ROW area were estimated using the As-Built Plan prepared by CES and reproduced as a modified As-Built Plan in **Figure 5.** The estimated length and width of residential parcels excluded the proposed parking areas behind the residential buildings. The estimated volumes of regulated waste are as follows:

- Block 62.01, Lots 1 through 4 - 3,695 cubic yards
- Block 62, Lots 17 through 20 - 5,568 cubic yards
- Block 62.02, Lots 25 and 26 - 1,520 cubic yards
- Pubic Use/ROW - 1,055 cubic yards

TOTAL: 11,838 cubic yards

The total quantity regulated waste that will be removed from the Site is estimated at 18,941 tons. The contractor will be required to import an equal amount of clean fill materials to the site to replace the excavated soils. A total cost for the remedial actions including costs for sampling, excavation, sheeting/shoring dewatering, transportation and disposal, and clean fill costs has been estimated at $2,100,000.

Institutional controls consisting of a Deed Notice will be established for the ABC Barrel Company site for areas where historic fill materials will remain on-site. The Deed Notice will be established for the public use/ROW areas and will consist of one (1) restricted area approximately 0.65 acres in size located within the central portion of the site and including the existing/proposed Centennial Avenue/Harris Way ROW. The contaminants of concern for the Deed Notice at a minimum will include metals and PAHs as shown on Sheet 1 of the Environmental Plans (**Figure 9**).

A Draft Deed Notice is being submitted with this RAW (**Appendix F).** The Final Deed Notice and a Soil Remedial Action Permit will be completed once the site remediation as proposed in this RAW is completed and surveying of the property boundary (metes and bounds) is completed by the contractor during the site remediation activities. The Deed Notice will have to be modified after the Phase II development is completed which will be funded under a separate contract.

Following completion of the remedial activities as described in this RAW, a Remedial Action Report (RAR) will be prepared for the ABC Barrel Company Site in accordance with the requirements of N.J.A.C. 7:26E-6.7. The Soil Remedial Action Permit and Final Deed Notice will be submitted with the RAR. Since the anticipated completion of the site remediation is Spring 2012, the RAR will be submitted in accordance with the requirements of New Jersey's Licensed Site Remediation Program (LSRP).

1.0 INTRODUCTION

1.1 Objectives and Scope of Work

The objective of this RAW is to present a detailed description of the remedial actions and the contaminated material management procedures that will be utilized during the ABC Barrel Company Site site remediation. Remedial actions were selected that would be protective of public health and the environmental during construction and for the intended use of the site. The proposed development option for the Site includes a combination of unrestrictive use for ten (10) residential parcels and restricted use for the public park and ROW areas.

The scope-of-work of the remedial actions includes the following:

<u>Pre-Excavation Activities:</u>

- Soil characterization/delineation sampling for AOC-B2 (Former 1,000-Gal Fuel Oil UST) and AOC-G (Former Drain/Trench/Piping Area) as per the recommendation of the SI/RAR Report;
- Abandonment of site monitoring wells prior to site remediation;
- In-situ sampling of the residential parcels for waste characterization sampling;
- In-situ sampling of the public use/ROW area for waste characterization sampling prior to placement of an engineering cap.

<u>Remedial Activities for Residential Parcels</u>

- Excavation of contaminated soils from within the residential parcels (from approximately 0.0 to 12 feet deep), direct loading, and off-site disposal of ID-27 regulated waste;
- Shoring and sheet piling of excavations, construction dewatering, treatment, and on-site recharge of contaminated liquids pursuant to a NJ Discharge to Groundwater Permit-by-Rule Authorization;
- Placement and compaction of clean fill materials in areas where historic fill was removed from the residential parcels.

<u>Remedial Activities for Public Use Areas</u>

- Limited excavation of contaminated surface soils (down to approximately 1-foot below grade);
- Transportation and disposal of ID-27 regulated waste;

- Placement and compaction of two (2) feet of clean cap materials.

Post-Excavation Activities:

- Preparation of a Remedial Action Report
- Preparation of a Soil Remedial Action Permit and filing of a Deed Notice for the public use areas/ROW.

1.2 Site Description

The ABC Barrel Company Site (a.k.a. AABCO Steel Drum Site) is located just south of the Ben Franklin Bridge at 308-322 North Front Street in the City of Camden, Camden County, New Jersey. The Site consists of an approximate 1.0 acre irregular-shaped rectangular parcel located between North 2nd Street and North Front Street just north of Penn Street. The site is currently vacant.

The subject site is bordered on the north by attached houses (row homes) and partially to the south by row homes and newer townhomes (recently constructed on Block 62 Lots 21, 22, and 23). A paved driveway was constructed in 2008 adjacent to the south side of Block 62 Lot 38 (partially within the former Centennial Avenue ROW) for access to the north side of the townhomes. A small portion of the subject property extends to the south between the row homes and townhomes that connects to Penn Street.

1.3 Site Development Plan

An As-Built Site Plan for Cooper Grant Homes-Phase II, dated 4/30/2010 and prepared by Consulting Engineering Services (CES) was made available for this RAW. A modified version of this plan is presented as **Figure 4**. A schematic Site Development Plan for the Cooper Grant Homes – Phase II project, has been prepared by CGNA, dated 3-29-11, is presented as **Figure 5**. It should be noted that the CES plans are included only for development of former Block 62 Lots 38 and 45 parcels, which have been subdivided into ten (10) residential parcels and a public ROW. As shown on the Site Development Plan, the parcels proposed for development are:

- Block 62.01, Lots 1 through 4: Four (4) 2-story townhomes (1 each lot)
- Block 62, Lots 17 through 20: Four (4) 3-story townhomes (1 each lot)
- Block 62.02, Lots 1 and 2: Two (2) 3-story townhomes (1 each lot)

Entrances to the townhomes will be from North Front Street, North Second Street, and Centennial Street as shown on **Figure 5**. To the north, east, and west of the townhomes are paved parking areas on each lot behind the buildings with access to either Centennial Avenue or proposed Harris Way. Harris Memorial Park is proposed for the courtyard area behind the townhomes. Proposed Harris Way will loop around the park area and exit north of the townhomes to North Front Street.

1.3.1 Construction Details

Based upon review of the Building Construction Details by Kitchen & Associates Architectural Services, Inc., dated 3/22/05, the planned townhomes will include a basement with building slab/foundation set at approximately 5 feet $2^1/_4$-inches below proposed grade. Average proposed grade elevations appear to be similar to the existing grade elevations [$^+/-$ 8 to 12 feet Mean Sea Level (MSL)]. Total depth of the basement foundation/slab is estimated at approximately six (6) feet below existing grade.

Based upon a review of the Preliminary/Final Site Development Plans for Cooper Grant Homes dated 1-19-07, the site development includes construction of asphalt roadways, driveways, concrete curbs, sidewalks, walkways, landscaped areas, and utilities such as sanitary sewer lines, storm sewer lines, a water main, and associated features. It should be noted that RAW details the remedial activities that will be conducted prior to the building phase of the project which is designated as “Phase II”. Therefore, the CES Site Development Plans are not provided in the RAW, although they will be available to the contractor as part of the bid package in support of the site remediation work.

2.0 BACKGROUND

2.1 Historic Site Usage

According to available historic reports for the ABC Barrel Company Site (AABCO Steel Drum, Inc.), since 1885, the Site has been used for industrial and manufacturing purposes. Since about the 1960’s, the AABCO Steel Drum facility operated at the site on Lots 38 and 45. The various operations occurred within and adjacent to Buildings No. 1, No. 2, and No. 3 as shown on the Site Plan in **Figure 3**.

Prior to November 1987, the AABCO Steel Drum facility operations consisted of the reconditioning of steel drums by cleaning and painting open-ended drums, which was reportedly performed indoors. In 1987, the AABCO changed its name to Container Recyclers after which time the site was reportedly used to store clean drums. During the drum cleaning operations, the facility reportedly only accepted drums that could be cleaned using a caustic soda process. Hazardous wastes were generated at the facility included residual oil and rinse water from the drum washing process. Residual oil was initially collected in waste drums and later in a waste oil tank. It was reported that the waste oil was removed from the facility within 90 days by a licensed hazardous waste hauler. Wastes consisting of paint and solvent were also likely to have been generated during the drum painting process but documentation was not available to confirm this waste stream. The caustic soda rinse was reportedly pretreated then passed through an oil-water separator where sludge and oils were separated out. The remaining fluids were discharged to the sanitary sewer via a CCMUA discharge permit.

Recent Site History
In July 2000, all building structures on-site were demolished following completion of USEPA removal actions at the Site. In February 2005 CRA initiated site development activities by removing the existing building foundations and slabs (former Buildings No. 1 and 2). At that time, a registered 8,000-Gal Diesel UST and Piping designated as AOC-B1 was excavated and removed along with two (2) 1,000-Gal. Heating Oil USTs (AOC-B2 and AOC-B3). Available site information indicated that three additional AOCs (AOC-C - Concrete Pit area; AOC-G - floor drain/piping/trench area; and AOC-O - oil-water separator) were also removed (**Figure 3**). The materials removed during excavation for the building slabs were used to backfill the excavations.

In October 2007, the site was cleared of all remaining debris and the land surface graded. A 6-inch thick layer of topsoil and seeding was placed over the entire site as temporary cover prior to the site redevelopment.

2.2 Regional Setting

2.2.1 Land Use

Based upon NJDEP's Geographic Information System (GIS) database updated in 2002, the subject Site is classified as 'Miscellaneous Built Land'. Land use north of the Site along Linden Street and west/southwest of the Site along Front Street and Penn Street is classified as residential usage. Outward from these residential areas land use is classified as commercial or recreational. Land use adjacent to the southeast corner of the site is classified as commercial usage, however, subsequent to 2002, new row houses and a paved driveway have been constructed along the southeast corner of the Site.

2.2.2 Geology

The subject Site is located in the inner part of the Coastal Plain Physiographic Province in southern New Jersey. The Site is located on a former floodplain approximately 1500 feet east of the Delaware River. According to the USGS 7.5-Minute Topographic Maps of the study area [Camden, NJ-PA Revised 1994/Philadelphia, PA-NJ Photorevised 1995], ground surface in the vicinity of the Site is flat with ground surface elevations less than twenty (20) feet above Mean Sea Level (MSL).

Based upon the US Geological Survey *Bedrock Geology Map of Central and Southern, New Jersey*, the subject site is underlain by the unconsolidated Lower Cretaceous Age Potomac Formation (Map Unit Kp3). The Potomac Formation in this area is composed of predominantly mottled red, white, and orange-brown clay to clay-silt, interbedded with thin beds and lenses fine to medium grained micaceous sand. According to the New Jersey Geologic Survey's *Periglacial Features of Southern New Jersey,* published October, 2003, surficial deposits underlying the study area include Pleistocene Age marine-estuarine terrace deposits (Cape May Formation). These deposits are ringed by recent estuarine/marsh deposit associated with the Delaware River and adjoining estuary channels. The Cape May Formation is composed of quartz sand and pebble gravel and is less than 40 feet thick.

Natural and man-made fill materials are widespread in the project area. These materials include 'historic fill' which was placed over natural deposits during historic development of the area. Historic fill investigations indicated that historic fill materials and related contamination were present down to a depth of approximately twelve (12) feet bgs. The historic fill materials overly native deposits consisting predominantly of sand and silty sand with a little miscellaneous debris (see Soil Boring/Well Logs in **Appendix C**).

2.2.3 Hydrogeology

Based upon the regional hydrogeologic setting and site data, a shallow unconsolidated aquifer is present underlying the study area. The water table in the unconsolidated aquifer was observed to be present within the historic fill materials as described above. Depth to groundwater measured in Site monitoring wells varied from approximately 9 feet to 12 feet below ground surface.

The Delaware River is a major discharge zone in the study area. Based upon the regional location, groundwater at the Site is expected to generally flow to the west towards the Delaware River. This is consistent with historic groundwater elevation contour maps of the Site which show groundwater flow direction to southwest. Due to the distance of the Site to the Delaware River, groundwater levels are not expected to be significantly influenced by tidal flow in the Delaware River channel. It should be noted, however, that local groundwater flow conditions at the Site may vary from the regional flow due to various local factors, such as hydraulic control from localized trenches, utility lines, old channels, or groundwater pumping/recharge.

2.2.4 NJDEP Well Search/Groundwater Usage

On June 18, 2001, Remington and Vernick Engineers (Remington & Vernick) conducted a NJDEP Well Search to identify domestic wells within a ½-half mile radius from the Site, and irrigation and public wells within a 1-mile radius of the Site. The reported results of the well-search indicated that five (5) non-potable domestic wells and six (6) public wells were identified within the study area. In 2009, Dresdner Robin conducted a NJDEP GIS database search for public supply wells to determine if any supply wells are located within approximately 2000 feet of the Site boundary. No public supply wells were identified. Public water in the City of Camden is supplied by United Water Company.

2.2.5 Surface Water Bodies and Wetlands

As discussed above, the nearest body of surface water is the Delaware River located approximately 1500 feet west of the Site. A search of the NJDEP GIS database for surface water bodies and wetlands indicated that two small wetland areas are located within the county park adjacent to the Delaware River. No other surface water bodies or wetland areas were identified in the vicinity of Site.

2.3 Historic Remedial Activities- 1996 through 2001

Between 1996 and 2009, various investigations and remedial actions were conducted on behalf of the CRA for the ABC Barrel Company (Case #95-09-14-1206-53). The investigations included a Preliminary Assessment/Site Investigation (PA/SI), a Site Investigation (SI), a Remedial Investigation (RI); and a Site Investigation for Removal of an 8,000-Gal. Diesel UST and Piping. The results of these investigations were reported in the following documents:

1. Preliminary Assessment Report for the City of Camden, AABCO Steel Drum Incorporated, Block 62 Lots 38 and 45; Block 65 Lot 103, Camden City, Camden County, Remington & Vernick Engineers, December 1996;

2. Site Investigation Report for the City of Camden, AABCO Steel Drum Incorporated, Block 62 Lots 38 and 42; Block 65 Lot 103, Camden City, Camden County, Remington & Vernick Engineers, April 1999;

3. Remedial Investigation Report – AABCO Steel Drum, Inc., 308 to 322 North Front Street and 320 North 2nd Street, City of Camden Block 62 Lots 38 & 45; Block 65 Lot 103; Remington & Vernick Engineers, October 2002; and

4. Site Investigation Report (8,000-Gal. Diesel UST and Piping)- Cooper Grant Developers, LLC, 308-322 N. Front Street, Camden City, Camden County, New Jersey, ENVision, Inc., February 2006.

In addition to the above, during July 2000, the US Environmental Protection Agency (EPA) conducted remedial activities at the “Container Recyclers Site” located at 308-322 North Front Street (ABBCO Steel Drum, Inc. Site). A summary of the work activities and the results of the above investigations are presented in the SAMP in **Attachment D**.

2.4 UST/Soil Remedial Actions- 2005 to 2006

In February 2005, removal actions were completed EHS Environmental, Inc. (EHS) on behalf of Cooper Grant Developers, LLC for the following AOCs:

- AOC-B1: Former 8,000-Gal.Diesel UST System
- AOC-B2: 1,000-Gal. Fuel Oil/Waste Oil UST
- AOC-B3: 1,000-Gal. Waste Oil UST
- AOC-C1-6: Concrete Pit area inside Buildings No. 1 & 2
- AOC-G: Floor drain/trench/piping outside Building No. 2
- AOC-O: Oil-water separator outside Building No. 2

In addition to the above, in March 2006, React Environmental Professional Services Group (REPSG) on behalf of CRA completed UST and contaminated soil excavation and removals for

AOC-B1, AOC-B3, AOC-C1 and C6, AOC-G, and AOC-O. The locations of the contaminated soil excavation areas are shown on **Figure 6**. Details of the above remedial actions were presented in the RIR/RAR and are discussed in the SAMP (**Appendix D**).

2.5 AOCs Requiring Further Remedial Action

In an April 6, 2006 correspondence, NJDEP required that a remedial investigation/remedial action report be submitted pursuant to N.J.A.C. 7:26E for the following twelve (12) AOC's:

- AOC-B1 8,000-Gallon Diesel UST and Associated Piping
- AOC-B2 1,000-Gallon Fuel Oil UST and Associated Piping
- AOC-B3 1,000-Gallon Liquid Waste UST
- AOC-C1/C6 Caustic Wash/Drum Rinse/Concrete Pit Areas
- AOC D/K Loading/Off-loading Areas
- AOC E/M Drum Storage Yard Areas
- AOC-G Floor Drain/Trench/Piping
- AOC-I Underground Piping
- AOC-O Oil Water Separator
- AOC-P1 Elevator Pit (Southwest Corner Bldg. No. 1)

In addition, NJDEP required that a groundwater investigation be conducted for AOC-B1. If excavation and disposal was not selected as the remedial strategy for site development, Institutional and Engineering Controls would be required to address "historic fill materials" beneath the Site.

In accordance with NJDEP requirements, during 2007 through 2009, Dresdner Robin conducted a supplemental groundwater remedial investigation for AOC-B1. The findings of this investigation are summarized in Section 3 and discussed in the SAMP (**Appendix D**).

3.0 REMEDIAL INVESTIGATION SUMMARY

3.1 RIR/RAR -July 2010

In accordance with NJDEP's Correspondence dated August 24, 2006 (**Appendix A**), an RIR/RAR was prepared that summarized the historic remedial activities conducted by others at the Site from 1996 through 2006, and presented the results of the supplemental groundwater investigation conducted by Dresdner Robin during 2007 through 2009. CRA received the following correspondence from NJDEP's Bureau of Southern Field Operations regarding the RIR/RAR:

1) A Remedial Investigation Report Approval Letter (Soils Only), dated September 30, 2010; and

2) A No Further Action Letter (NFA) for Groundwater, dated Sept. 30, 2010

The NJDEP Approval Letter (**Appendix A**) required that a Remedial Action Workplan (RAW) be submitted within 1-year of the approval date. On September 1, 2010, a request for a 180-day extension to complete the RAW was submitted to NJDEP, however, no response was received back from NJDEP. The NFA for groundwater at the Site requires that the site monitoring wells be abandoned pursuant to N.J.S.A. 584A. Pursuant to N.J.A.C. 7:26E, the findings and recommendations of the remedial investigation as reported in the RIR/RAR are presented below.

3.2 RIR/RAR- Findings

- *Soil- AOC-B1*- In February 2005 EHS completed removal of the regulated 8,000-Gal. Diesel UST and Piping (AOC-B1). The *Site Investigation Report* dated February 10, 2006 reported that concentrations of TPH and VOCs in the post-excavation soil samples were below the NJDEP Soil Cleanup Criteria (SCC). Consequently, NJDEP required no further actions for AOC-B1. On March 31, 2006, additional excavation, post-excavation sampling, and contaminated soil removal were completed for AOC-B1. It was reported that 667 cubic yards (cy) of additional soil was removed and properly disposed. The results of post excavation samples indicated that concentrations of TPH and VOCs were below the NJDEP SCC.

- *Soil- AOC-B3, C1-C5, C6, and O*- In March 2006, REPSG completed additional excavation, post-excavation soil sampling, and contaminated soil removal for the former 1,000-Gal. Liquid Waste UST located along the south side of Building No. 1 (AOC-B3); the former Caustic Wash/Drum Rinsing/Pit Area inside Building No. 1 (AOC-C1 to C5); the former Concrete Pit Area inside Building No. 2 (AOC-C6); and the former Oil Water Separator adjacent to the south side of Building No. 2 (AOC-O). It was reported that a total of 386 cy of contaminated soil was removed and properly disposed. As reported by REPSG, the results of post excavation samples collected indicated that concentrations were below the NJDEP SCC.

- *Soil- AOC-B2*- In their August 25, 2008 Comment Letter, NJDEP indicated that it could not be determined if further remedial actions were required for the 1,000-Gal Fuel Oil UST and piping until the tank and product in the tank were removed. Although available historic information suggested the tank was removed during the February 2005 activities, specific information pertaining to the removal of AOC-B2 was not available. Furthermore, it could not be verified that remediation was completed for AOC-B2 during the March 2006 remedial activities.

- *Soil-AOC-G*- On March 31, 2006, REPSG completed additional excavation, post-excavation soil sampling, and contaminated soil removal for Floor Drain/Trench/Piping Area located adjacent to the southwest side of Building No. 1 (AOC-G). It was reported that 265 cy of additional soil was excavated and disposed off-site. The results of post excavation samples collected indicated that PCE was present in one (1) sample along the northeast sidewall of the excavation slightly exceeding the NJDEP SCC. Lead was also detected in five (5) samples and antimony in one (1) sample at concentrations exceeding the SCC.

- *Soil- AOC-D&K, E&M, I, and P1*- These AOCs were associated with the former loading/off-loading area adjacent to Building No. 1 and 2nd Street (AOC-D & K); the drum storage/yard area west of Buildings No. 1 and 2 (AOC-E&M); the underground piping south of Building No. 1 (AOC-I); and the elevator pit on the southwest side of Building No. 1 (AOC-P1). Soils in these areas were found to contain PAHs and metals, and therefore, were characterized during the site-wide 'historic fill' sampling.

- *Groundwater - AOC-B1*- In September 2007, a groundwater screening sample was collected within the former 8,000-Gal. Diesel UST excavation area that indicated PAHs, VO/BN TICs, and sheen were present exceeding the NJ Groundwater Quality Standards (GWQS). However, in 2008, the results of the screening sample were not confirmed by groundwater samples collected from monitoring well MW-4 installed adjacent to the screening location. The groundwater sampling results indicated that volatile and semi-volatile organic compounds and sheen were not present exceeding the GWQS.

3.3 RIR/RAR- Recommendations

The recommendations for AOCs which required further remedial activities as presented in the July 2010 RIR/RAR were as follows:

- AOC-B1/AOC-B3/AOC-C1-C5/AOC-C/AOC-0- No Further Action was recommended for soil;
- AOC-G and AOC-B2- To comply with N.J.A.C. 7:26E, further remedial actions were recommended for soil including: 1) characterization/delineation and removal of petroleum-impacted soils for AOC-B2, as necessary, and 2) delineation and removal of PCE-impacted soils for AOC-G;
- AOC-D&K, E&M, I, and P1- Institutional and Engineering Controls consisting of a Deed Notice and engineering cap was recommended for areas where historic fill materials will remain to comply with NJDEP requirements;
- Groundwater- a site-wide No Further Action was recommended; and
- RAW: preparation of a Remedial Action Work plan and Final Deed Notice was recommended for the ABC Barrel Site in support of the site development.

4.0 REMEDIAL ACTION SELECTION

4.1 Remedial Action Objectives/Goals

Pursuant to N.J.A.C. 7:26E-5.1, the objective of the Remedial Action Selection (RAS) for the ABC Barrel Co. Site is to select a remedial strategy or a combination of strategies that will: 1) reduce contaminant levels at the Site below the regulatory standards; 2) reduce or eliminate potential exposure to contaminants above the applicable remediation standards during the construction activities; and 3) reduce or eliminate potential exposure to contaminants above the applicable remediation standards for long-term Site usage. Consistent with the proposed development plans, this RAS has been developed for dual usage at the Site as follows:

- <u>Residential Usage</u>- Block 62.01 Lots 1 through 4; Block 62 Lots 17 through 20; and Block 62.02 Lots 25 and 26
- <u>Public Usage</u>- remainder of Site (Block 62 Lots 38 and 45)

The media of concern at the Site is limited to contaminated soils associated with site-wide historic fill materials and with individual AOCs as identified in the RIR. Groundwater has not been designated a media of concern at the Site since a No Further Action for groundwater has been issued by NJDEP. Because groundwater is not a media of concern and volatile organic compounds associated with historic AOCs have either been remediated or will actively be remediated as described in this RAW, potential vapor intrusion is not a concern for the Site.

To achieve the stated goals, active treatment has been selected for the future residential use areas while containment/exposure controls have been selected for the public use area. For contaminated soil, the following remedial actions have been selected to reduce/eliminate exposure:

1) <u>Residential parcels</u>- unrestricted use remedial action
2) <u>Public areas</u>: restrictive use remedial action

4.2 Remedial Standards/Cleanup Goals

The contaminants of concern for soil requiring further remedial actions are: 1) site-wide PAHs and metals associated with historic fill materials; and 2) tetrachloroethene in the former Trench/Floor Drain/Piping Area (AOC-G) south of Building #1. The distribution of the soil contamination exceeding the NJ Residential Direct Contact and/or Non-Residential Direct Contact Soil Remediation Standards (RDCSRS/NRDCSRS) based upon the site/remedial investigation data is shown on **Figure 9**.

In addition to the above, if Total Petroleum Hydrocarbons (TPH) or related contaminants are found exceeding the applicable Soil Remediation Standards (SRS) during the proposed sampling for the No.2 Fuel Oil Tank excavation area (AOC-B2), then TPH and/or related constituents will also be a contaminant of concern at the Site.

The proposed soil remediation standards and cleanup goals for the above contaminants of concern are as follows:

- Residential and Non-Residential Direct Contact Soil Remediation Standards (RDCSRS/NRDCSRS) as codified in N.J.A.C. 7:26D.

Based upon the reported results of groundwater investigations conducted at the ABC Barrel Co. Site and the No Further Action Letter that was issued for groundwater, Impact-to Groundwater Soil Remediation Standards (IGWSRS) are not applicable to the Site.

4.3 Protection of Public Health & Safety and Environment

Technical specifications (Specifications) are being developed that are designed to mitigate worker exposure to contaminated materials during site remediation. Furthermore, Environmental Plans have been prepared by Dresdner Robin on behalf of CRA that summarize the environmental conditions at the Site and specify contractor's requirements regarding health and safety during site operations. The selected contractor for the site remediation will be required to conduct his work in accordance with the Environmental Plans and Specifications during site activities. The Environmental Plans contain a listing of contract environmental requirements and commitments, including references to the Specifications, environmental laws and regulations, project permits, NJDEP Guidance Documents, the USEPA SAMP, and other project requirements.

The Environmental Plans and Specifications require that the contractor prepare and implement a Site Heath and Safety Plan (HASP) in accordance with the USEPA Occupational Safety and Health (OSHA) 29 CFR 1910.12 regulations. The purpose of the HASP will be to ensure that procedures are implemented that will eliminate or minimize worker exposure to contaminated materials during the remedial actions. Because the project has not yet been bid or awarded, the Contractor's Site HASP is not included in this RAW. The HASP will be submitted to NJDEP once it is reviewed by CRA's representative/Resident Engineer for compliance with the OSHA regulations prior to the start of excavation activities.

Long-term protective measures for the public use areas will be addressed by construction of an engineering cap over contaminated materials and implementation of a Deed Notice/Soil Remedial Action Permit. In conjunction with the Deed Notice, Biennial Certifications of the Deed Notice will ensure the long-term protectiveness of the remedial actions.

4.4 Effectiveness, Reliability, and Implementability

The remedial action proposed for the ten residential parcels (Block 62.01 Lots 1 through 4; Block 62 Lots 17 through 20; and Block 62.02 Lots 25 and 26) will consist of removal of historic fill materials down to native materials and replacement with clean certified fill materials. This unrestricted use remedial action will be the most effective and reliable option for the proposed usage. As a result, CRA is requesting that a No Further Action (NFA) be issued for soil for these parcels upon completion of the remedial actions.

Within the proposed pubic use area, remediation of all historic AOCs will be completed prior to construction of the public use areas. As proposed in this RAW, PCE-impacted soil associated with AOC-G and TPH-impacted soils (if any) identified during the proposed sampling of AOC-B2 will be excavated and disposed off-site prior to construction of the residential dwellings. Implementation of the EPA's Brownfield Site-Specific Sampling, Analysis, and Monitoring Plan as provided in **Appendix D** will help assure the effectiveness of these remedial actions.

The restricted use remedial action for the Harris Park public area will consist of placement of an engineering cap consisting of 2-feet of clean fill with landscaping materials during the site remediation phase, followed by construction of asphalt driveways, roadways, concrete curbs and other impermeable structures during the Phase II development phase of the project. The engineering cap will eliminate direct contact with underlying contaminated materials. The engineering cap in conjunction with establishment of Institutional Controls consisting of a Deed Notice coupled with implementation of a Biennial Certification program is a widely used strategy that is considered protective of human health and the environment.

5.0 DESCRIPTION OF REMEDIAL ACTIONS

5.1 Remedial Action Objectives/Applicable Standards

The overall objectives of the RAW for the ABC Barrel Company Site are: 1) to detail the selected remedial actions for AOC-G, and AOC-B2, and AOC-D&K, E&M, I, P1, and historic fill materials; 2) to reduce or eliminate short-term exposure to contaminants above the applicable remediation standards during the construction activities; and 3) to address long-term exposure to site contaminants after completion of the site redevelopment.

The contaminants of concern/areas of concern identified for soil requiring further actions are PCE and metals adjacent to the southwest side of Building No. 1 (AOC-G); and metals and PAHS associated with historic fill materials site-wide and in the vicinity of AOC-D&K, E&M, I, and P1. In addition, if contaminants are found to be present in the vicinity of the former 1,000-Gal Fuel Oil UST and piping exceeding the applicable remedial standards, than remedial actions will also be required for AOC-B2.

Remedial Standards/Cleanup Goals

The proposed soil remediation standards and cleanup goals for the Site are as follows:

- Residential and Non-Residential Direct Contact Soil Cleanup Criteria (RDCSCC/NRDCSCC) (N.J.A.C. 7:26D)

The groundwater remediation standards will only be applicable to the Site soils if the results of the proposed investigation for AOC-B2 indicate impacts to groundwater.

5.2 Soil Remedial Actions - AOC-G & AOC-B2

5.2.1 AOC-G- Former Floor Drain/Trench/Piping Area

The July 2010 RI/RAR recommended that soil delineation sampling be completed for PCE where concentrations were found to exceed the NJ Soil Remediation Standards. The reported results of post-excavation sampling for the floor drain/trench/piping area (located adjacent to the southwest side of former Building No.1) indicated that the following sample requires further remediation:

- Sample 06-PE-006 (6 feet bgs): PCE – 520 mg/kg

The location of soil sample 06-PE-006 is shown on **Figure 7**, the Soil Characterization/Delineation Sample Location Plan. The sample was collected from within Block 62 Lot 38 which is now proposed as a public use area/ROW. The delineation sampling will be completed by the Contractor prior to excavation for the residential lots and development of the public use areas. Dresdner Robin will conduct oversight of the Contractor and his representatives during the field sampling activities.

The delineation sampling will be conducted in accordance with N.J.A.C. 7:26E-4.3. A minimum of nine (9) delineation borings are proposed along with collection and analysis of soil samples for PCE as necessary to complete the horizontal and vertical delineation of impacted soils. The sample interval will be approximately 6-inches to four (4) feet below existing grade or deeper as needed to fully delineate the contamination. The approximate location of the delineation samples for AOC-G are shown on **Figure 7**.

A Soil Sampling Summary for delineation of AOC-G is presented provided in **Table 2**. Details of the proposed soil delineation sampling for AOC-G are presented in the SAMP (**Appendix D).**

Contaminated Soil Removal
After completion of the sampling and assessment of the field and analytical data, the volume of PCE-contaminated soils will be estimated. The contractor will then be required to excavate the contaminated soils, temporarily stockpile then on-site, collect stockpile samples for waste

characterization (if necessary), and dispose the soils off-site at a NJ-permitted facility. Contaminated soil management procedures for this work are presented in Section 6 of this RAW.

5.2.2 AOC-B2 – Former 1,000-Gal. Fuel Oil UST Area

The July 2010 RI/RAR recommended that a soil investigation be conducted for AOC-B2 to confirm that petroleum-related contamination has been removed following removal of the UST in 2005. AOC-B2 is located within Block 62 Lot 38 which is proposed for a public use area/ROW (**Figure 7**). The characterization sampling will be completed by the Contractor prior to excavation for the residential lots and the public use/ROW area. Dresdner Robin will conduct oversight of the contractor and his representatives during the field sampling activities.

The characterization sampling will be conducted in accordance with N.J.A.C.7:26E-3.6 and the area requirements for USTs. Four (4) soil borings are proposed for the centerline of the former UST excavation. Soils samples will be collected from a depth of 0-6-inches below the bottom of the former UST/excavation based upon the observed depth of the fill materials. If petroleum impacted soils are identified, than additional soil samples will be collected and analyzed to fully delineate the contamination. The samples will be submitted to a NJ-certified laboratory for analysis of EPH, with fractionization and contingency analysis of naphthalene/2-methylnaphthalene as required in accordance with NJDEP's *Protocol for Addressing Extractable Petroleum Hydrocarbons.* If field evidence indicates potential impacts to groundwater from the former UST, a groundwater screening sample will be collected during the investigation and analyzed for the potential contaminants of concern. If the analytical results indicate that contaminants of concern are present at concentrations that exceed the New Jersey Groundwater Remediation Standards (GWRS), that further groundwater investigation will be recommended.

The location of the proposed soil samples for AOC-B-2 are shown on **Figure 7**. A Soil Sampling Summary for AOC-B2 is presented in **Table 2**. Detailed field and analytical methods and procedures for the proposed sampling are discussed in the SAMP (**Appendix D).**

Contaminated Soil Removal

After completion of the proposed field sampling and assessment of the field and analytical data, the volume of petroleum-contaminated soils will be estimated. The contractor will then be required to excavate the contaminated soils, temporarily stockpile then on-site, collect stockpile samples for waste characterization as necessary, and dispose them off-site at a NJ-permitted facility.

5.3 Description of Remedial Actions - Residential Parcels

5.3.1 Overview

In support of the redevelopment activities, the selected remedial strategy for the residential parcels is as follows: 1) excavate all historic fill materials down to approximately 12 feet; 2) transport and dispose the excavated soils off-site as UID-27 regulated waste; and 3) import certified clean fill and use it to backfill the excavations up to the proposed grade.

The ten (1) residential parcels that will be remediated are: Block 62.01 Lots 1 through 4; Block 62 Lots 17 through 20; and Block 62.02 Lots 25 and 26 as shown by the proposed lot lines in **Figure 5**.

Prior to beginning the excavation activities, the contractor will be required to complete the following work:

- Seal all existing site monitoring wells
- Conduct in-situ waste classification of soils

The in-situ sampling method was selected because there will be limited area at the site during excavation activities for stockpiling of soils. The waste classification sampling data will be used to obtain approval from a disposal facility to accept the regulated waste.

In support of the proposed remedial actions for the residential parcels, physical conditions at the site indicate that the contractor will likely need to employ the following construction methods and procedures:

- Sheeting and shoring of excavations
- Dewatering of excavations

In support of the construction activities, the most cost-effective and practical method for management of contaminated liquids during excavation dewatering is by discharge on-site via an infiltration basin. The information necessary for issuance of the Permit-by-Rule Authorization is provided in Section 5.3.4 of the RAW.

Following completion of the excavation and removal of the historic fill materials, the contractor will be required to import clean certified fill materials and backfill/compact them in the excavations up to existing grade or as requested by CRA’s representative/Resident Engineer.

5.3.2 In-Situ Waste Classification Sampling

The Contractor will perform in-situ soil sampling in accordance with the SAMP as presented in **Appendix D**. The SAMP includes detailed information on sampling rational, sampling procedures, frequency of sampling, analytical parameters and methodology, and quality assurance control requirements for sampling. Dresdner Robin will oversee the contractor’s implementation of the in-situ waste sampling program.

In general, sampling procedures utilized by the contractor will be in compliance with NJDEP's *Field Sampling Procedures Manual*, which is referenced in Section F-1.2 of the SAMP. In addition, the contractor shall utilize waste sampling protocols that are in compliance with the selected NJ-Permitted waste disposal, recycling, or beneficial reuse facility.

A sampling summary for the in-situ waste classification program for the residential parcels is presented in **Table 3**. The sampling summary was developed for this RAW using the sampling frequency and analytical testing requirements of Clean Earth's Philadelphia Treatment Facility for historic fill materials. For example, to estimate the total amount of samples required for a specific analysis, the required frequency (i.e., one grab sample per 180 tons for EPH/semi-volatiles, one composite sample per 900 tons for metals/TCLP, etc.) was divided by the expected total tonnage. It should be emphasized that the contractor's sampling program for waste classification may vary from **Table 3** if a different disposal facility is selected and approved.

5.3.3 Removal of Historic Fill Materials

The contractor will be required excavate all historic fill materials from the residential parcels within the limits as a shown on **Figure 10**, Sheet 2 of the Environmental Plans. Historic site data showing the concentration of contaminants detected in historic fill is provided in **Figure 9,** Sheet 1 of the Environmental Plans. The contractor will direct load the excavated waste materials onto trucks for transportation to the selected disposal facility.

Volumes of historic fill were estimated for the residential parcels using an average depth of twelve (12) feet, which was based upon the results of historic fill characterization borings conducted at the Site by Remington & Vernick during the SI. The area of each parcel was estimated from the proposed lot lines which excludes the parking areas behind the residential building. A detailed estimate of the volume of regulated waste to be excavated and removed and the assumptions made for the estimate are presented in **Table 4**. A summary of the regulated waste volumes for the residential parcels is as follows:

- Block 62.01, Lots 1 through 4 - 3,695 cubic yards
- Block 62, Lots 17 through 20 - 5,568 cubic yards
- Block 62.02, Lots 25 and 26 - 1,520 cubic yards

TOTAL: 10,783 cubic yards

5.3.4 Construction Dewatering/Permit-by-Rule Authorization

Construction dewatering will likely be required during the remedial actions on the above residential parcels to remove seepage and runoff into the excavations during the site remediation. Therefore, the selected contractor will be required to implement groundwater and contaminated stormwater management procedures during the construction dewatering activities Although is not possible to accurately predict the volume of contaminated liquid that may be removed from the excavations, the use of sheeting by the contractor is expected to minimize the amount of groundwater and seepage entering into the excavation.

During construction dewatering activities, it is proposed to manage contaminated liquids by discharge to an on-site infiltration basin, located within the proposed ROW area as shown on **Figure 10**, Sheet 2 of the Environmental Plans. To accomplish this, CRA hereby requests that NJDEP issue a New Jersey Pollution Discharge Elimination System (NJPDES) Permit-b-Rule Discharge Authorization for the project to allow on-site recharge of groundwater during construction dewatering activities. The information contained in this section and the RAW is being provided as background information to support issuance of the Permit-by Rule.

Groundwater analytical results from monitoring well MW-4 which is located in the proposed public use/ROW area of the Site are presented in **Table 5**. The groundwater sampling was conducted by Dresdner Robin in December 2008 during the groundwater investigation for AOC-B1. The samples were analyzed for TCL-volatile organic compounds (Method 8260), semi-volatiles (Method 8270C), and PAHs (8260B by Sims). Quality assurance/quality control samples were collected during the sampling in accordance with NJDEP requirements and the results are included in **Table 5**. The results of the sampling indicated that contaminants were not present at concentrations exceeding the Groundwater Remediation Standards.

In support of the requested Permit-by-Rule, the contractor will be required to remove suspended sediment from the discharge by use of a ‘frac’ tank or other approved method. In addition, the use of an oil-water separator will be required to remove any petroleum sheen from the discharge prior to recharge to the infiltration basin. Effluent sampling is not proposed since the quality of the water being recharged is expected to be similar to background groundwater quality at the Site.

The contractor or his representative will monitor and document compliance of the dewatering/treatment activities with the Permit-By-Rule and make changes as necessary to comply with the Permit-by-Rule requirements.

5.3.5 Import/Placement of Clean Fill

The contractor will be required to import NJDEP “certified clean fill material” to the site to replace the excavated historic fill removed from the residential parcels. The clean fill materials will be backfilled and compacted in the excavations up to the existing grades or as required by CRA’s representative/Resident Engineer. The limits of the imported fill areas are shown on **Figure 10.**

The clean fill materials imported by the contractor must comply with NJDEP’s requirements as described in *Fill Guidance at SRP Sites*, dated August 11, 2001. In general, the contractor shall submit documentation describing the nature and origin of the materials including the results of environmental and/or geotechnical analysis as required by CRA’s representative/Resident Engineer. The imported fill materials will be of engineering grade materials and be approved by CRA’s representative/Resident Engineer prior to transport and use at the Site. The contractor will backfill and compact the fill material in lifts up until the existing grade or as requested by

CRA's representative/Resident Engineer in accordance with the methods and procedures as detailed in the contract specifications.

5.4 Description of Remedial Actions - Harris Park Public Area/ROW

5.4.1 Historic Fill Excavation

The contractor will be required to excavate historic fill materials (+/-1 foot below existing grade) within the public use/ROW areas. The purpose of this work is to prepare the land surface for placement of a 2-foot thick engineering cap over the contaminated soil area. The limits of the areas requiring excavation are shown on Sheet 2 of the Environmental Plans (**Figure 10**).Because of the limited working space at the site, it is anticipated that the contractor will complete this work after removal of the historic fill from the residential parcels.

The historic fill removal for the public use/ROW areas is estimated to generate approximately 1,055 cubic yards of regulated waste for off-site disposal. Details of the estimate are provided in **Table 4**.

5.4.2 Engineering Cap Placement

Construction of a 2-foot thick engineering cap on the public use/ROW areas is required to mitigate exposure to contaminated surface soils prior to completion of Phase II development of the Site. The engineering cap will consist of NJDEP certified clean fill materials as described in *Fill Guidance at SRP Sites.* The location of the engineering cap is coincident with the excavation areas as shown for the public use/ROW areas in Sheet 2 of the Environmental Plans (**Figure 10**).

The RAW does not include work effort related to Phase II of the project. Phase II of the project includes construction of the residential dwellings and related features such as parking areas, utilities, roadways, etc., which will be completed under a separate contract. Therefore, the engineering cap in these areas will include primarily clean engineering grade materials which at a later date may function as base aggregate material for roadway or other paved surfaces.

Details of the proposed engineering cap for the public use/ROW areas are shown on **Figure 11**. The engineering cap includes landscaped materials at the surface which will enhance the engineering cap. Placement of the engineering cap during this phase of the project will allow a Deed Notice to be prepared and filed with the County prior to the Phase II development of the Site.

5.5 Abandonment of Existing Monitoring Wells

The selected contractor will be required to seal all existing monitoring wells at the Site prior to beginning any excavation activities. The monitoring wells will be sealed by a NJ-certified driller in accordance with the requirement of N.J.A.C. 7:9D, the Well Construction Rule. The monitoring wells identified for well abandonment include MW-1 through MW-4, at the locations shown on Sheet 2 of the Environmental Plans (**Figure 10**). The contractor shall submit NJDEP well abandonment reports to CRA's representative/Resident Engineer upon completion of the work.

6.0 CONTAMINATED MATERIAL MANAGEMENT PROCEDURES

6.1 General

This section discusses the contaminated material handling and management procedures for the ABC Barrel Company site remediation. The procedures as referenced in this section are designed to be protective of human health and the environment. A bid package with Technical Specifications will be prepared for the project that details the remedial construction requirements. The environmental-related work is contained in the following sections of the specifications:

- Section 1: Site Remediation
- Section 2- Health and Safety
- Section 3- Odor and Dust Control
- Section 4- Soil Erosion and Sediment Control
- Section 5- Stormwater Runoff and Fluids Control
- Section 6- Imported Fill Environmental Quality Control
- Section 7- Excavation, Backfilling and Compaction
- Section 8-Management of Contaminated Debris, Soil and Liquids

The selected contractor will be required to perform the remedial activities in accordance with the Environmental Plans and Specifications and in accordance with all applicable local, state, and federal laws and regulations, and project permits. The contaminated material handling and management procedures detailed in the Specifications and in the RAW consist of the following:

- Contaminated soil excavation, loading, stockpiling, transportation, and disposal of regulated waste; and
- Contaminated liquids dewatering, treatment, and on-site recharge

It should be noted that the soil handling and management procedures described in this section are applicable to both 'non-hazardous' and 'hazardous' regulated waste. Although it is expected that the regulated waste generated will most likely be classified as 'non-hazardous', final determination will be made by the selected receiving facility based upon the results of the waste classification sampling conducted by the contactor in accordance with the facility requirements.

6.2 Contaminated Soil Excavation and Loading

The selected contractor will be required to supply all necessary personnel, equipment, and materials to excavate the contaminated soil at the locations shown on Sheet 2 of the Environmental Plans (**Figure 10**). The contractor will be required to direct load the contaminated soil into trucks for off-site removal as described in Section 6.4 below.

6.3 Stockpiling/Staging of Contaminated Soils

The Contractor shall provide all personnel, materials and equipment needed to properly store (and dewater, if necessary) regulated waste in temporary stockpiles. Contaminated soil stocking will most likely be limited to temporary stockpiling of soils removed during the remediation of AOC-G and excavation for the infiltration basin on the public use/ROW area. The contaminated soil will be staged adjacent to the infiltration basin and backfilled and compacted in the excavation upon completion of dewatering activities. The location of the proposed staging area for the stockpiled soils is shown on Environmental Plan Sheet 2 **(Figure 10)**.

The contaminated soil stockpiles will be managed by the contractor in a manner that is consistent with the requirements of NJDEP's *Guidance Document for Remediation of Contaminate Soils*, dated 1998. Stockpiles shall only be placed on dry areas on a layer of minimum 10mils thick PVC sheeting or similar, and contained with hay bales or silt fence placed continuously at the perimeter of the stockpile(s). Stockpile shall be constructed so that heights shall not exceed 4.5 meters, nor with side slopes steeper than one vertical and two horizontal.

The Contractor shall provide protection for the regulated waste stockpiles to prevent the run-on of stormwater, migration of contaminants, dusting, erosion and unauthorized contact. Stockpiles shall be covered with PVC sheeting of the same thickness. The sheeting shall be secured in place with tie downs and/or heavy objects such as concrete blocks at the end of each workday and during adverse weather conditions.

Regulated waste not suitable for construction activities and/or reuse, shall not be stockpiled for more than 180 days. Regulated waste subsequently classified as hazardous shall be properly stage and removed within 90 days of excavation. In addition, the contractor will be required to manage dewatering fluids from regulated waste stockpiles in manner that is consistent NJDEP guidelines.

6.4 Transportation and Off-Site Disposal of Regulated Waste

The loaded soils will be transported off-site to a NJ-permitted facility as selected by the contractor and approved by the CRA's representative/Resident Engineer. The contactor will transport the regulated waste in accordance with the applicable *New Jersey Solid and/or Hazardous Waste Regulations.* Since the project is not yet out for bid, the contractor and the disposal facilities will be determined at later date. The contractor may submit more than one disposal facilities as there is potential for regulated waste to be grossly contaminated or hazardous. Prior to removal of regulated waste from the site, the contractor will be required to submit copies of the facilities approval documentation to CRA's representative/Resident Engineer for approval.

The contractor will be required to use licensed and insured waste haulers for the off-site transportation of regulated waste. Prior to off-site transportation and upon arrival at the disposal facility, the truck is typically weighed using a certified scale. The Contractor will submit all requested waste disposal documentation to CRA's representative/Resident Engineer including but not limited to: waste profiles; bills of laden or waste manifests; hauler and disposal facility permits and insurance information; disposal facility tickets; and other related information.

6.5 Excavation Dewatering

The project Specifications will require that the contractor provide all personnel, materials and equipment necessary to remove contaminated liquids during dewatering activities. During the anticipated dewatering activities for the residential parcels, the contractor will be required to use dewatering sumps, submersible and/or "trash" pumps, and rubber hosing free of leaks to efficiently remove the liquids from the excavation to the on-site recharge basin.

In addition, the contractor will be required to prepare a *Pollution Prevention and Control Plan* (PPCP) detailing the methods and procedures for use during handling, collection, storage and control of contaminated groundwater, storm water runoff, decant liquids, decontamination fluids, and accidental spills and leaks of hazardous liquids. The PPCP will incorporate methods and procedures as recommended by the "New Jersey Storm Water Best Management Practices Manual" February 2004. The methods and procedures proposed in the PPCP will be approved by CRA's representative/Resident Engineer prior to start of excavation activities.

6.6 Treatment/Oil-Water Separator

The selected contractor will be required to select a treatment method that is consistent with the type of contamination identified at the Site as shown on **Figure 9**, Sheet 1 of the Environmental Plans. Historic fill materials contain varying concentrations of PAHs and metal compounds which will tend to adsorb to the suspended particles in the discharge. Therefore, removal of sediment will be required prior to on-site discharge. To accomplish this, the contractor shall contain the turbid discharge in the infiltration basin or if necessary use a frac tank or other approved methods to remove the suspended particles from the discharge.

Due to the potential for petroleum sheen to be present in groundwater at the Site, the contractor will be required to provide all personnel, materials and equipment to mobilize, operate and maintain an oil-water separator for removal of free product during dewatering activities in areas of petroleum-contaminated soils. The oil-water separator used by the contractor will conform with industry standard specifications and be operated in accordance with the manufacturer’s recommended operating procedure. Sediment or petroleum product removed during the treatment process will be disposed in accordance with the contaminated material management procedures specified in this RAW and in accordance with the NJ Solid Waste Management Act (NJSA B:13 E-1).

6.7 On-site Recharge via Infiltration Basin

The Contractor will be required to construct an infiltration basin to recharge contaminated liquids removed from the excavations during the construction dewatering activities. The contractor is expected to employ sheeting or other methods to help minimize the volume of water requiring management during dewatering activities. The quality of water recharged to the infiltration basin shall be similar to that of the groundwater and shall not result in degradation of soil quality at the recharge location.

To meet these objectives, the contractor will construct an infiltration basin adjacent to the excavation area that will be of sufficient size to contain the expected discharge of water and sediment. The dimensions of the infiltration basin will be compatible with the rate of pumping and the volume of area to be dewatered. To allow infiltration and recharge of groundwater, the bottom of the dewatering basin will be constructed a minimum of two (2) feet above the water table. The areas adjacent to the basin will be graded to prevent standing water and surface water from entering the basin.

After the site remediation is completed, the basin will be backfilled and compacted with the same soil that is excavated such that the stratigraphic sequence and continuity of the soil layers/types is maintained. The proposed location of the dewatering basin is shown on **Figure 10**, Sheet 2 of the Environmental Plans.

6.8 Soil Erosion and Sediment Control

A *Soil Erosion and Sediment Control Plan* (SESCP) has been prepared for the ABC Barrel Company Site by CES as part of the Site Development Plans. The SESCP is presented in **Appendix C** of the RAW. The plan will be updated as necessary and submit to the appropriate authorities for their approval. After approval the required number of copies of the Soil Conservation District approved plan will be provided to agencies having jurisdiction for permits, records or other purposes.

The proposed soil erosion and sediment control practices were designed to comply with the requirements of the "Standards for Soil Erosion and Sediment Control in New Jersey" including the latest addenda.

6.9 Compliance Monitoring/Documentation

The selected contractor will be required to monitor and record on Daily Tracking Logs the source location, type, quantity, and characteristics of regulated waste excavated, stockpiled, removed or managed at the Site (soil and water). The contractor shall submit copies of the above documentation to CRA's representative/Resident Engineer for each workday involving excavation, dewatering, stockpiling, transportation and disposal of regulated waste.

The Daily Tracking Log will be required to contain, at a minimum, the following information:

A) Date of activities
B) Location(s) of excavation and placement of material,
C) Volume of regulated waste removed,
D) Location and duration of dewatering/treatment/recharge
E) Name(s) and signature(s) of the Contractor representative(s) responsible for preparing and executing the Usage Tracking Log.

CRA's representative/Resident Engineer will review and approve the documentation provided by the contractor for regulated waste management, transportation and disposal prior to the start of excavation for the project. Dresdner Robin will conduct daily/weekly site inspections during the remedial actions to monitor compliance with the project's Environmental Plans and Specifications. The inspections will be documented in a dedicated field notebook, and the remedial activities photo documented.

7.0 QUALITY ASSURANCE PROJECT PLAN / SITE-SPECIFIC SAMPLING, ANALYSIS, AND MONITORING PLAN

In a November 25, 2001 fax to CRA, USEPA authorized the use USEPA's Region 2 Generic Brownfield's Quality Assurance Project Plan (QAPP) to comply with the provisions of CRA's Brownfield Hazardous Substance Clean Grant for the ABC Barrel Company Project (Cooperative Agreement No. BF 97216211). Furthermore, USEPA's Region 2 Brownfield's Project Manager has authorized CRA to use the Generic Brownfield's QAPP Boilerplate to prepare a Site-Specific Sampling, Analysis, and Monitoring Plan (SAMP) for the ABC Barrel Company project. The USEPA correspondence for the QAPP is provided in **Appendix E**.

The detailed SAMP for the project based upon the QAPP Boilerplate is presented in **Appendix D** of the RAW. The scope of work as detailed in the SAMP includes: 1) characterization and delineation sampling as required under the NJDEP SRP for AOC-G and AOC-B2; and 2) in-situ waste classification for the residential parcel areas and the public use/ROW area at the site.

8.0 SITE-SPECIFIC HEALTH & SAFETY PLAN

The project Environmental Plans and Specifications will require the selected contractor to develop and implement a Site Specific Health and Safety Plan (HASP) in accordance with OSHA 29 CFR 1910.12 and other applicable regulations. Because the contractor has not yet been selected for the project, the Site-Specific HASP has not been submitted with the RAW.

Prior to start of the remedial activities, the Resident Engineer will approve the contractor's HASP. The HASP will be submitted to NJDEP once it is approved.

9.0 SITE RESTORATION PLAN

Site restoration activities for the residential parcels will consist of placement and compaction of certified clean fill materials to the existing grade in accordance with the Environmental Plans and Specifications or as required by CRA's representative/Resident Engineer. On the public use/ROW areas, an engineering cap will be constructed by placing 2-feet of clean fill materials on top of historic fill materials up to the existing or as required by CRA's representative/Resident Engineer. The fill materials on all areas of the Site will be seeded/landscaped so as to establish a grass cover prior to the Phase II development activities.

10.0 ENGINEERING AND INSTITUTIONAL CONTROLS

As recommended in the ABC Barrel Company RIR/RAR, engineering and institutional controls (an engineering cap and deed notice) were proposed for contaminated soil remaining on-site at concentrations that exceed New Jersey's Residential Direct Contact Soil Remediation Standards. Therefore, the engineering and institutional controls will be established for the public use/ROW areas where historic fill materials will not be removed.

Placement of the engineering cap is discussed in Section 5.4.2 of the RAW and details of the cap are presented in **Figure 11**. The Draft Deed Notice for the ABC Barrel Company public use/ROW areas is being prepared pursuant to the requirements of N.J.A.C 7:26E-8.2 and accordance with applicable NJDEP guidance. The Draft Deed Notice will contain one (1) restricted area consisting of approximately 0.65 acres within the central portion of the site and including the existing/proposed Centennial Avenue/Harris Way ROW and adjacent areas within the property boundary. The contaminants of concern for the Deed Notice at a minimum will include metals and PAHs as shown on Sheet 1 of the Environmental Plans (**Figure 9**).

A Draft Deed Notice is being submitted as **Appendix G** of the RAW. The Final Deed Notice will be completed and submitted to NJDEP once the site remediation is completed as proposed in this RAW and the metes and bounds survey of the property is completed by the contractor. At that time a Soil Remedial Permit and Final Deed Notice will be filed with NJDEP and Camden County.

11.0 REMEDIAL ACTION REPORT

Following completion of the remedial activities as described in this RAW, Dresdner Robin on behalf of CRA will prepare a Remedial Action Report (RAR) for the ABC Barrel Company Site. The format of the report will correspondence to the outline of N.J.A.C. 7:26E6.7. The report will include a site investigation summary, a description of the remedial actions completed by AOC; As-Built diagrams; a description of the site restoration activities; a copy of the filed Deed Notice along with a Remedial Action Permit form; and documentation of the remedial activities such as the volume of soil removed, fully executed waste manifests, and other required information.

Based upon the anticipated site remediation schedule, the RAR will be submitted in accordance with the requirements of New Jersey's Licensed Site Remediation Program (LSRP).

12.0 REMEDIAL ACTION COST ESTIMATE

Remedial action costs have been estimated for the selected ABC Barrel Company site development option as detailed in the RAW. The development option includes removal of historic fill materials from all lots proposed for residential buildings, with the remaining park area/ROW (to be owned by the City) capped with 2 feet of clean fill and landscape materials prior to Phase II development. The estimated costs are as follows:

Item	Quantity	Unit	Unit Cost ($)	Total Cost
Excavation and Load of ID-27 Waste	185,000	ls	1	$185,000
Sheeting/Shoring	10,000	sq. ft.	40	$400,000
Construction Dewatering	20	day	750	$15,000
Treatment/on-site recharge	1	ls	25,000	$25,000
Clean Fill Costs	19,000	tons	15	$285,000
Transport./Disposal of ID-27 Waste	19,000	tons	60	$1,140,000
Analytical Laboratory Costs	1	ls	50,000	$50,000
			TOTAL	**$2,100,000**

The above total estimates for transportation/disposal of ID-27 waste and clean fill costs were based upon detailed analysis for each parcel as presented in **Table 4** of the RAW. The estimate for the analytical laboratory costs is based upon the proposed sampling plan summarized in **Table 2** and **Table 3** and as detailed the SAMP **(Appendix D)**. Assumptions for the cost estimate are as follows.

1) Excavation of ID-27 waste includes mobilization and operating costs for one (1) excavator, field crew and supervisor, assuming 30 truck loads per day for 40 days total (load ID 27-waste/off-load clean fill).

2) Quantity of ID-27 waste is based upon a property dimensions of approx. 24,264 sq. ft. with 12 feet thickness of historic fill (total 10,784 cubic yards x 1.6 =17,254.4 tons) plus 1055 cy or 1688 tons of historic fill removed from the capping areas outside of the residential properties.

3) Sheeting/shoring assumes installation of sheeting/shoring around the perimeter of the two larger residential parcel areas to support excavation to 12 feet below grade (excluding parking areas behind the residential buildings which will become part of the ROW).

4) Treatment and on-site recharge of contaminated liquids during construction dewatering includes excavation/backfilling of an infiltration trench, sediment removal, and oil water separation prior to recharge, in accordance with a NJPDES Permit-by-Rule Authorization.

5) Clean fill costs are for replacement of all historic fill excavated and removed from the residential parcels and for placement of 2-feet of engineering cap on the public use/ROW areas at the site.

6) Consultant costs are not included for environmental inspections, management, or reporting.

13.0 PUBLIC NOTIFICATION/COMMUNITY OUTREACH

A community involvement plan will be prepared by CRA to inform residents and the local community of the status of the project. Copies of the RAW will be submitted to the local agencies as required pursuant to N.J.AC. 7:26E-3. To comply with NJDEP's public notification requirements, CRA will either post a sign at the Site prior to initiation of the proposed remedial actions, or prepare and send out notification letter to property owners within 200 feet of the Site in accordance with NJDEP public notification requirements.

14.0 SCHEDULE

A schedule for the implementation of the proposed work is not being provided at this time pending award of the bid and receipt of the construction schedule from the selected contactor. The schedule will be forwarded to NJDEP once it is received. It is anticipated that the project will go out for bid in the first quarter of 2012 and project start-up will be in Spring 2012.

TABLES

TABLE 1
SUMMARY OF HISTORICAL AREAS OF CONCERN (in 2006)
ABC BARREL COMPANY BLOCK 62 LOTS 38 & 45
CAMDEN REDEVELOPEMENT AGENCY
REMEDIAL ACTION WORKPLAN

Area of Concern	AOC Description	AOC Location	Contaminants of Concern	Delineation Completed	Active Remediation Completed	NJDEP Requirements	Remedial Actions Completed (as of 2006)
AOC B1	8,000- Gal. Diesel UST & Piping	NE Side of Bldg. #2	TPHC	Yes	Yes	Groundwater Investigation	NFA - Soil Groundwater Investigation
AOC B2	1,000-Gal. Fuel Oil UST & Piping	NE Side of Bldg. #2	None	N/A	Yes	RIR/RAR	Tank Removal RIR/RAR Preparation
AOC B3	1,000-Gal. Liquid Waste UST	Adjacent to Bldg. 1	VOs, BNS, TPH Metals, phenol	Yes	Yes	RIR/RAR	RIR/RAR Preparation
AOC C							
AOC C1	Caustic Wash Area/Pipe Run/ Concrete Pit Area	Inside Bldg. #1	(see AOC B3)	(see AOC B3)	(see AOC B3)	(see AOC B3)	(see AOC B3)
AOC C2	Drum Rinse Area /Pipe Run/ Sediments/Concrete Pit Area	Inside Bldg. #1	VOs, BNs, metals	Yes	Yes	RIR/RAR	RIR/RAR Preparation
AOC C3	Drum Rinse Area /Concrete Pit Area	Inside Bldg. #1	BNs, metals	Yes	Yes	RIR/RAR	As Above
AOC C4	Caustic Wash Area /Sediments/ Concrete Pit Area	Inside Bldg. #1	VOs, BNs, metals, TPH	Yes	Yes	RIR/RAR	As Above
AOC C5	Drum Rinse Area/Sediments/ Concrete Pit Area	Inside Bldg. #1	BNs, metals	Yes	Yes	RIR/RAR	As Above
AOC C6	Pit Area	Inside Bldg. #2	BNs, metals	Yes	Yes	RIR/RAR	As ABove
AOCs D & K							
AOC D1	Loading/Off Loading Area	Bldg. #1/near 2nd Street	BNs	Yes	No		RIR/RAR Preparation
AOC D2	Loading/Off Loading Area	Bldg. #1/Southwest side	BNs	Yes	No		RIR/RAR Preparation
AOC D3	Loading/Off Loading Area	Bldg. #2 /adjacent to AOC-B1	(see AOC B1 - E/M & O)	(see AOC B1 - E/M & O)	(see AOC B1 - E/M & O)	(see AOC B1 - E/M & O)	(see AOC B1 - E/M & O)
AOCs E & J	Drum Storage/Yard Area	Various locations west of Bldgs. #1 & 2	BNs, pesticides metals, TPH	Yes	Yes	RIR/RAR	RIR/RAR Preparation
AOC G	Floor Drain/Trench/Piping	Along south side of Bldg. #1	VOs, BNs, metals, TPH, phenol	Yes	Yes	RIR/RAR	RIR/RAR Preparation
AOC I	Underground Piping	South of Bldg. #1	(see AOCs B-C-G & O)	(see AOCs B-C-G & O)	(see AOCs B-C-G & O)	(see AOCs B-C-G & O)	(see AOCs B-C-G & O)
AOC O	Oil Water Separator & Assoc. Piping	Yard adjacent to Bldg. #1	VOs, BNs, metals, TPH, phenol	Yes	Yes	RIR/RAR	RIR/RAR Preparation
AOC P							
AOC P1	Elevator Pit	Bldg. #1/southwest side	metals	Yes	Unknown	RIR/RAR	RIR/RAR Preparation
ND	Historic Fill	Entire Site (0 to 12 ft. deep)	BNs, metals	Yes	No (see Note 1)	Engineering and Institutional Controls	Remedial Action Workplan

TPH = Total Petroleum Hydrocarbons
BN = Base Neutrals
VO = Volatile Organics
RIR = Remedial Investigation Report
RAR = Remedial Action Report
CEA = Classification Exception Area
ND= not designated
Note: Summary of AOC's is based upon review of NJDEP's April 6, 2006 Correspondence

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Table 2
Soil Sampling Summary for Characterization/Delineation
ABC Barrel Company Site
City of Camden, Camden County, NJ
Remedial Action Workplan

AOC/ Block & Lot	*Proposed Soil Boring*	*Type of Sample*	*Sample Interval*	*Sample Method*	*Sample Analysis*
AOC-G			(feet)		
Block 62	DB-0	Soil	0.0-0.5	Grab	Tetrachloroethene
Lot 38	(06-PE-005)	Soil	2.0-4.0	Grab	Tetrachloroethene
		Soil	4.0-6.0	Grab	Tetrachloroethene
			(feet)		
	DB-1 & DB-2	Soil	0.0-0.5	Grab	Tetrachloroethene
	(north of DB-0)	Soil	2.0-4.0	Grab	Tetrachloroethene
		Soil	4.0-6.0	Grab	Tetrachloroethene
			(feet)		
	DB-3 & DB-4	Soil	0.0-0.5	Grab	Tetrachloroethene
	(east of DB-0)	Soil	2.0-4.0	Grab	Tetrachloroethene
		Soil	4.0-6.0	Grab	Tetrachloroethene
			(feet)		
	DB-5 & DB-6	Soil	0.0-0.5	Grab	Tetrachloroethene
	(south of DB-0)	Soil	2.0-4.0	Grab	Tetrachloroethene
		Soil	4.0-6.0	Grab	Tetrachloroethene
			(feet)		
	DB-7 & DB-8	Soil	0.0-0.5	Grab	Tetrachloroethene
	(west of DB-0)	Soil	2.0-4.0	Grab	Tetrachloroethene
		Soil	4.0-6.0	Grab	Tetrachloroethene
AOC-B-2			(feet)		
Block 62	B2-1	Soil	0-6" below UST	Grab	Extractable Petroleum
Lot 38	B2-2	Soil	0-6" below UST	Grab	Hydrocarbons[1]
	B2-3	Soil	0-6" below UST	Grab	Naphthalene &
	B2-4	Soil	0-6" below UST	Grab	2-Methynaphthalene

1- EPH as per NJDEP's *Extractable Petroleum Hydrocarbon Methodology,* Document #EPH 10/08, dated August 2010, Rev. 3

Notes:

1) All samples will be biased towards the greatest evidence of contamination (staining, PID readings, odor, etc.)
2) Additional step-out borings will be conducted as necessary to complete horizontal delineation of contamination
3) Additional soil samples will be collected as necessary to complete the vertical delineation of contamination
4) Quality assurance/quality control samples will be collected in accordance with N.J.A.C. 7:26E-2.
5) See SAMP for details of the sampling methods and procedures
6) If physical evidence of contamination is detected in characterization borings B2-1 to B2-4 as described above, than a delineation sampling program will be conducted pursuant to N.J.A.C. 7:26E-4.3 (Remediation of Soil) and 4.4 [Remediation of Groundwater (if applicable)].
7) Frequency of samples and analytical protocols for AOC-B2 (former 1,000-Gal. Fuel Oil UST) is based upon NJDEP's area-wide requirements for USTs and Table 2-1 of the Technical Requirements for Site Remediation

Table 3
Soil Sampling Summary for Waste Classification
ABC Barrel Company Site- Cooper Grant Homes
City of Camden, Camden County, NJ
Remedial Action Workplan

Block and Lot	*Proposed Soil Boring*	*Type of Sample*	*Sample Interval*	*Sample Method*	*Sample Analysis*
			(all borings)	*(all borings)*	*(all borings)*
Block 62			*(feet)*		
Lot 1	B1-1 & B1-2	Soil	0.5 to 3.0	Grab	EPH/Semi-Volatile Compounds
Lot 2	B2-1 & B2-2	Soil	3.0 to 6.0	Grab	EPH/Semi-Volatile Compounds
Lot 3	B3-1 & B3-2	Soil	6.0 to 9.0	Grab	EPH/Semi-Volatile Compounds
Lot 4	B4-1 & B4-2	Soil	9.0 to 12.0	Grab	EPH/Semi-Volatile Compounds
		Soil	Variable	Grab	Volatile Organics/TCLP Volatiles
		Soil	0.5 to 12.0	5-Part Composite	PCBs/Total Metals/Sulfur
		Soil	0.5 to 12.0	5-Part Composite	TCLP/RCRA Parameters
Block 62			*(feet)*		
Lot 17	B17-1 thru B17-3	Soil	0.5 to 3.0	Grab	EPH/Semi-Volatile Compounds
Lot 18	B18-1 thru B18-3	Soil	3.0 to 6.0	Grab	EPH/Semi-Volatile Compounds
Lot 19	B19-1 thru B19-3	Soil	6.0 to 9.0	Grab	EPH/Semi-Volatile Compounds
Lot 20	B20-1 thru B20-3	Soil	9.0 to 12.0	Grab	EPH/Semi-Volatile Compounds
		Soil	Variable	Grab	Volatile Organics/TCLP Volatiles
		Soil	0.5 to 12.0	5-Part Composite	PCBs/Total Metals/Sulfur
		Soil	0.5 to 12.0	5-Part Composite	TCLP/RCRA Parameters
Block 62			*(feet)*		
Lot 24	B24-1	Soil	0.5 to 3.0	Grab	EPH/Semi-Volatile Compounds
Lot 25	B25-1	Soil	3.0 to 6.0	Grab	EPH/Semi-Volatile Compounds
		Soil	6.0 to 9.0	Grab	EPH/Semi-Volatile Compounds
		Soil	9.0 to 12.0	Grab	EPH/Semi-Volatile Compounds
		Soil	Variable	Grab	Volatile Organics/TCLP Volatiles
		Soil	0.5 to 12.0	5-Part Composite	PCBs/Total Metals/Sulfur
		Soil	0.5 to 12.0	5-Part Composite	TCLP/RCRA Parameters
Waste Classification			*feet*		
Block 62	ROW-1 thru 9	Soil	0.5 to 1.0	Grab	EPH/Semi-Volatile Compounds
Lot 38 & 45	ROW-1 thru 9	Soil	0.5 to 1.0	Grab	Volatile Organics/TCLP Volatiles
	ROW-1 thru 9	Soil	0.5 to 1.0	5-Part Composite	PCBs/Total Metals/Sulfur
	ROW-1 thru 9	Soil	0.5 to 1.0	5-Part Composite	TCLP/RCRA Parameters

Notes:
1) All samples will be biased towards the greatest evidence of contamination (staining, PID readings, odor, etc.)
2) Additional step-out borings will be conducted as necessary to complete horizontal delineation of contamination
3) Additional soil samples will be collected as necessary to complete the vertical delineation of contamination
4) Quality assurance/quality control samples will be collected in accordance with N.J.A.C. 7:26E-2.
5) Details of the sampling progam are provided in the SAMP
6) Analytical protocols and frequency of samples for waste classification is based on Clean Earth of Philadelphia requirements for historic fill:
-EPH [extractable petroleum hydrocarbons (Method 8270C/8270D)] and semi-volatiles (Method SW 8270B): approx. 1 sample per 180 tons
-Volatile organics (Method SW8260B): 1 grab sample per 900 tons
- PCBs (Method SW 8082A), metals (Method SW 6010), and sulfur (ASTM D129): one 5-part composite sample every 900 tons
-TCLP Extraction-Hazardous Waste Toxicity by Method SW1311: one 5-part composite sample every 900 tons
-RCRA Parameters (Ignitability, Corrosivity, Reactivity) by Methods 1010A/9040C/SW846: one 5-part composite sample every 900 tons

TABLE 4
Regulated Waste Excavation/Disposal Volumes and Costs
ABC Barrel Company Site
City of Camden, Camden County, New Jersey
Remedial Action Workplan

Lot and Block/ Construction Feature	Total Estimated Length	Total Estimated Width	Total Estimated Depth	Excavated Regulated Waste	Estimated Clean Fill Required	Transport. & Disposal Costs	Imported Clean Fill Costs
Block 62	*feet*	*feet*	*feet*	*tons*	*tons*	*($60/ton)*	*($15/ton)*
Lot 1	77	27	12	1,478	1,478	$88,704	$22,176
Lot 2	77	27	12	1,478	1,478	$88,704	$22,176
Lot 3	77	27	12	1,478	1,478	$88,704	$22,176
Lot 4	77	27	12	1,478	1,478	$88,704	$22,176
Block 62	*feet*	*feet*	*feet*	*tons*	*tons*	*($60/ton)*	*($15/ton)*
Lot 11	108	29	12	2,227	2,227	$133,632	$33,408
Lot 12	108	29	12	2,227	2,227	$133,632	$33,408
Lot 13	108	29	12	2,227	2,227	$133,632	$33,408
Lot 14	108	29	12	2,227	2,227	$133,632	$33,408
Block 62	*feet*	*feet*	*feet*	*tons*	*tons*	*($60/ton)*	*($15/ton)*
Lot 24	82	18	12	1,050	1,050	$62,976	$15,744
Lot 25	72	27	12	1,382	1,382	$82,944	$20,736
			Subtotals:	***17,254.40***	***17,254.40***	***$1,035,264***	***$258,816***
Block 62 Lots 38 & 45	*feet*	*feet*	*feet*	*tons*	*tons*	*($60/ton)*	*($15/ton)*
Engineering cap	169	169	1	1,688	1,688	$101,256	$25,320
			Subtotals:	***1,688***	***1,688***	***$101,256***	***$25,320***
			TOTALS:	**18,942**	**18,942**	**$1,136,520**	**$284,136**
				11,838	***cubic yards***		

Notes:

1) Costs shown above do not include contractor labor and material costs for contaminated soil excavation, loading, sheeting/shoring, construction dewatering, treatment, stockpile management, sampling, or providing coarce aggregate as per construction details
2) All historic fill materials will be excavated down to approximately 12 feet on Block 62 proposed Lots 1 to 4, 11 to 14, and 24 & 25
3) Block 62 Lots 38 & 45 includes the proposed park and common areas
4) All excavated historic fill materials are assumed regulated waste for disposal purposes
5) Volumes of regulated waste are based upon the estimated size of the excavation required for the proposed residential buildings
6) Volume estimates for the residential dwellings include exta length and width that may be required for sheeting
7) Depths of the excavations for foundations are based upon the construction details provided by Kitchen & Asociates and CES
8) The volume estimate for the residental dwellings assumes that the proposed grade is equal to the existing grade
9) Estimated tonnage is based upon a bulk density factor of 1.6
10) Total ROW area is based upon As-Built Plan provided by CES; length and width of ROW as shown assumes the ROW is a square

Table 5
Groundwater Analytical Results - December 15, 2008
Camden Redevelopment Agency
ABC Barrel Site, 314-322 N. Front Street, Camden, NJ

0 Laboratory Sample ID: Sampling Date: Dilution Factor(s): Sampling Depth (feet): Matrix:	Ground Water Criteria	TCLP Maximum Contaminant Concentrations	MW-4 JA8234-1 12/15/2008 1 Ground Water	REP121508 JA8234-2 12/15/2008 1 Ground Water	FB121508 JA8234-3 12/15/2008 1 Field Blank Water	TB121508 JA8234-4 12/15/2008 Trip Blank Water
GC/MS Semi-volatiles (ppb) (SW846 8270C)						
4-Bromophenyl phenyl ether	NS	NS	0.42 U	0.43 U	0.64 U	NA
Butyl benzyl phthalate	100	NS	0.43 U	0.43 U	0.64 U	NA
2-Chloronaphthalene	600	NS	0.49 U	0.50 U	0.74 U	NA
4-Chloroaniline	30	NS	0.34 U	0.34 U	0.51 U	NA
Carbazole	NS	NS	0.46 U	0.46 U	0.69 U	NA
bis(2-Chloroethoxy)methane	NS	NS	0.53 U	0.53 U	0.80 U	NA
bis(2-Chloroethyl)ether	7	NS	0.50 U	0.51 U	0.76 U	NA
bis(2-Chloroisopropyl)ether	300	NS	0.56 U	0.56 U	0.84 U	NA
4-Chlorophenyl phenyl ether	NS	NS	0.46 U	0.47 U	0.70 U	NA
1,2-Dichlorobenzene	600	NS	0.36 U	0.36 U	0.54 U	NA
1,3-Dichlorobenzene	600	NS	0.34 U	0.34 U	0.51 U	NA
1,4-Dichlorobenzene	75	7500	0.36 U	0.36 U	0.54 U	NA
2,4-Dinitrotoluene	NS	130	0.46 U	0.47 U	0.70 U	NA
2,6-Dinitrotoluene	NS	NS	0.61 U	0.62 U	0.93 U	NA
3,3'-Dichlorobenzidine	30	NS	4.6 U	4.7 U	7.0 U	NA
Dibenzofuran	NS	NS	0.50 U	0.50 U	0.75 U	NA
Di-n-butyl phthalate	700	NS	0.51 U	0.51 U	0.77 U	NA
Di-n-octyl phthalate	100	NS	0.51 U	0.51 U	0.76 U	NA
Diethyl phthalate	6000	NS	0.37 U	0.37 U	0.55 U	NA
Dimethyl phthalate	NS	NS	0.37 U	0.37 U	0.56 U	NA
bis(2-Ethylhexyl)phthalate	3	NS	0.77 U	0.77 U	1.2 U	NA
Hexachlorobutadiene	1	500	0.38 U	0.39 U	0.58 U	NA
Hexachlorocyclopentadiene	40	NS	4.6 U	4.7 U	7.0 U	NA
Hexachloroethane	7	3000	0.31 U	0.31 U	0.46 U	NA
Isophorone	40	NS	0.71 U	0.71 U	1.1 U	NA
2-Methylnaphthalene	NS	NS	0.44 U	0.45 U	0.67 U	NA
2-Nitroaniline	NS	NS	0.45 U	0.46 U	0.68 U	NA
3-Nitroaniline	NS	NS	0.46 U	0.46 U	0.69 U	NA
4-Nitroaniline	NS	NS	0.46 U	0.47 U	0.70 U	NA
Nitrobenzene	6	2000	0.67 U	0.68 U	1.0 U	NA
N-Nitroso-di-n-propylamine	10	NS	0.40 U	0.41 U	0.61 U	NA
N-Nitrosodiphenylamine	10	NS	0.62 U	0.63 U	0.93 U	NA
1,2,4-Trichlorobenzene	9	NS	0.38 U	0.38 U	0.57 U	NA
TOTAL TARGETED GC/MS Semi-volatiles (ppb)			0	0	0	0
TOTAL NON-TARGETED GC/MS Semi-volatiles (ppb)	NS	NS	0	0	0	NA
TOTAL GC/MS Semi-volatiles (ppb)			0	0	0	0

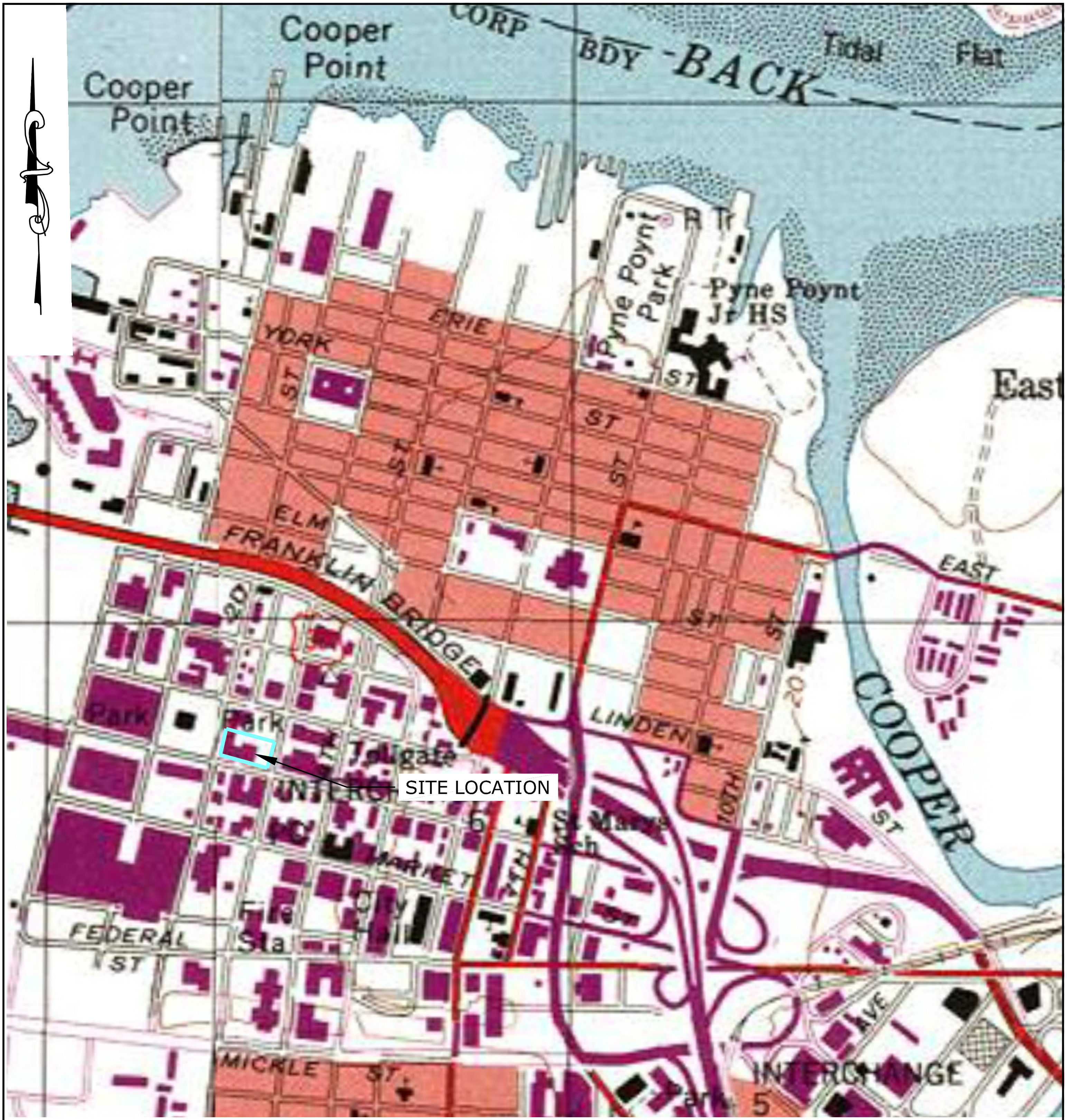
Table 5
Groundwater Analytical Results - December 15, 2008
Camden Redevelopment Agency
ABC Barrel Site, 314-322 N. Front Street, Camden, NJ

Sample ID: Laboratory Sample ID: Sampling Date: Dilution Factor(s): Sampling Depth (feet): Matrix:	Ground Water Criteria	MW-4 JA8234-1 12/15/2008 1 Ground Water	REP121508 JA8234-2 12/15/2008 1 Ground Water	FB121508 JA8234-3 12/15/2008 1 Field Blank Water	TB121508 JA8234-4 12/15/2008 Trip Blank Water
GC/MS Semi-volatiles (ppb) (SW846 8270C BY SIM)					
Acenaphthene	400	0.016 U	0.016 U	0.025 U	NA
Acenaphthylene	NS	0.0071 U	0.0072 U	0.011 U	NA
Anthracene	2000	0.021 U	0.022 U	0.032 U	NA
Benzo(a)anthracene	0.1	0.034 U	0.035 U	0.052 U	NA
Benzo(a)pyrene	0.1	0.036 U	0.037 U	0.055 U	NA
Benzo(b)fluoranthene	0.2	0.017 U	0.018 U	0.026 U	NA
Benzo(g,h,i)perylene	NS	0.012 U	0.012 U	0.018 U	NA
Benzo(k)fluoranthene	0.5	0.019 U	0.019 U	0.029 U	NA
Chrysene	5	0.018 U	0.018 U	0.027 U	NA
Dibenzo(a,h)anthracene	0.3	0.021 U	0.021 U	0.031 U	NA
Fluoranthene	300	0.0098 U	0.0099 U	0.015 U	NA
Fluorene	300	0.020 U	0.020 U	0.030 U	NA
Hexachlorobenzene	0.02	0.010 U	0.010 U	0.015 U	NA
Indeno(1,2,3-cd)pyrene	0.2	0.015 U	0.015 U	0.022 U	NA
Naphthalene	300	0.014 U	0.014 U	0.021 U	NA
Phenanthrene	NS	0.017 U	0.018 U	0.026 U	NA
Pyrene	200	0.012 U	0.012 U	0.019 U	NA
TOTAL TARGETED GC/MS Semi-volatiles (ppb)		0	0	0	0

Table 5
Groundwater Analytical Results - December 15, 2008
Camden Redevelopment Agency
ABC Barrel Site, 314-322 N. Front Street, Camden, NJ

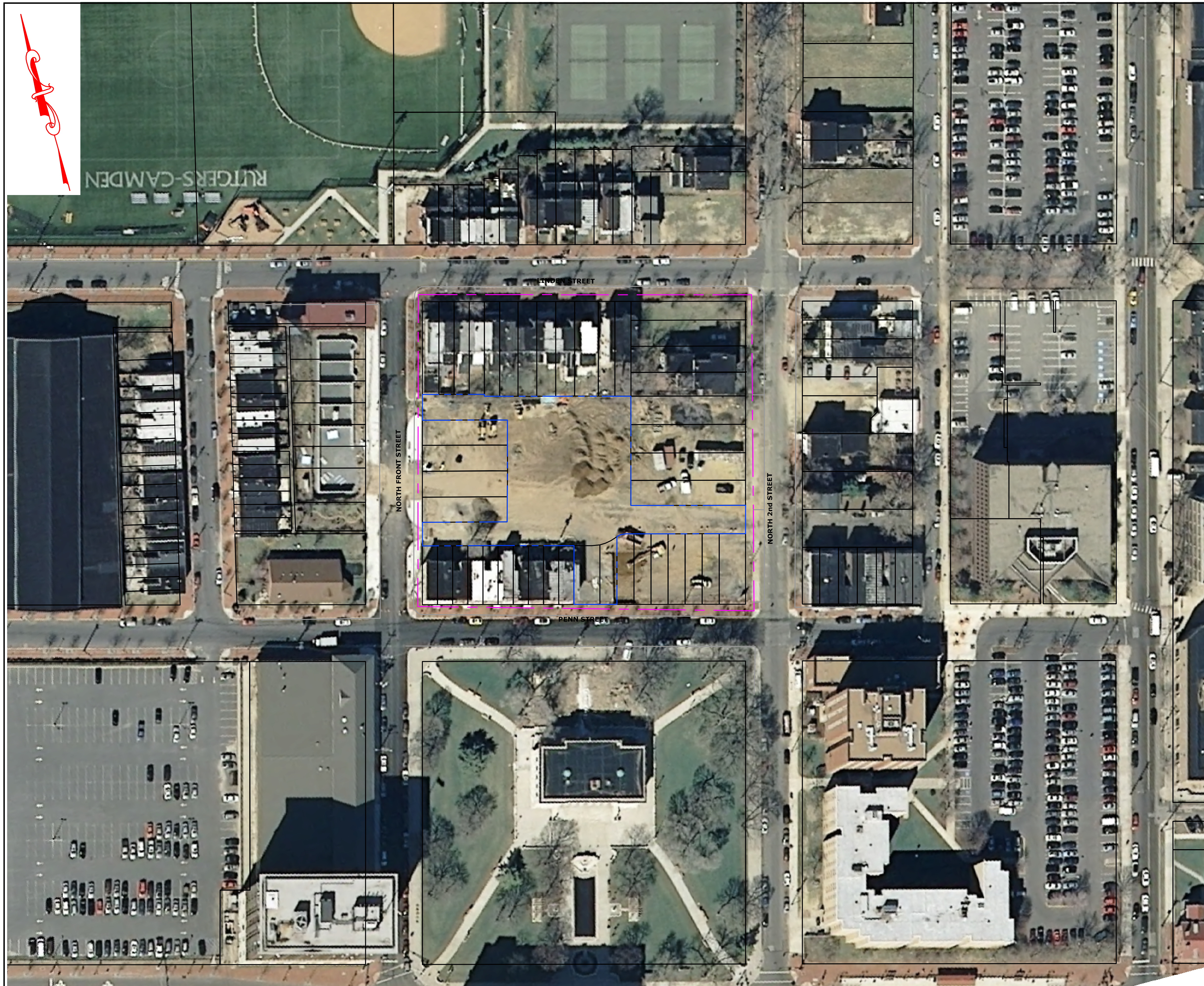
Sample ID: Laboratory Sample ID: Sampling Date: Dilution Factor(s): Sampling Depth (feet): Matrix:	NJDEP Ground Water Criteria	MW-4 JA8234-1 12/15/2008 1 Ground Water	REP121508 JA8234-2 12/15/2008 1 Ground Water	FB121508 JA8234-3 12/15/2008 1 Field Blank Water	TB121508 JA8234-4 12/15/2008 1 Trip Blank Water
GC/MS Volatiles (ppb) (SW846 8260B)					
Acetone	6000	2.1 U	2.1 U	8.3 J	8.5 J
Benzene	1	0.26 U	0.26 U	0.26 U	0.26 U
Bromodichloromethane	1	0.14 U	0.14 U	0.14 U	0.14 U
Bromoform	4	0.18 U	0.18 U	0.18 U	0.18 U
Bromomethane	10	0.32 U	0.32 U	0.32 U	0.32 U
2-Butanone (MEK)	300	2.3 U	2.3 U	2.3 U	2.3 U
Carbon disulfide	700	0.16 U	0.16 U	0.16 U	0.16 U
Carbon tetrachloride	1	0.18 U	0.18 U	0.18 U	0.18 U
Chlorobenzene	50	0.19 U	0.19 U	0.19 U	0.19 U
Chloroethane	NS	0.22 U	0.22 U	0.22 U	0.22 U
Chloroform	70	0.16 U	0.16 U	4.5	4.3
Chloromethane	NS	0.29 U	0.29 U	0.29 U	0.29 U
Dibromochloromethane	1	0.16 U	0.16 U	0.16 U	0.16 U
1,1-Dichloroethane	50	0.24 U	0.24 U	0.24 U	0.24 U
1,2-Dichloroethane	2	0.35 U	0.35 U	0.35 U	0.35 U
1,1-Dichloroethene	1	0.29 U	0.29 U	0.29 U	0.29 U
cis-1,2-Dichloroethene	70	0.25 U	0.25 U	0.25 U	0.25 U
trans-1,2-Dichloroethene	100	0.16 U	0.16 U	0.16 U	0.16 U
1,2-Dichloroethene (total)	70	0.16 U	0.16 U	0.16 U	0.16 U
1,2-Dichloropropane	1	0.18 U	0.18 U	0.18 U	0.18 U
cis-1,3-Dichloropropene	NS	0.18 U	0.18 U	0.18 U	0.18 U
trans-1,3-Dichloropropene	NS	0.15 U	0.15 U	0.15 U	0.15 U
Ethylbenzene	700	0.27 U	0.27 U	0.27 U	0.27 U
2-Hexanone	NS	1.7 U	1.7 U	1.7 U	1.7 U
4-Methyl-2-pentanone(MIBK)	NS	1.3 U	1.3 U	1.3 U	1.3 U
Methylene chloride	3	0.16 U	0.16 U	0.16 U	0.16 U
Styrene	100	0.17 U	0.17 U	0.17 U	0.17 U
1,1,2,2-Tetrachloroethane	1	0.13 U	0.13 U	0.13 U	0.13 U
Tetrachloroethene	1	0.30 J	0.29 U	0.29 U	0.29 U
Toluene	600	0.15 U	0.15 U	0.15 U	0.15 U
1,1,1-Trichloroethane	30	0.24 U	0.24 U	0.24 U	0.24 U
1,1,2-Trichloroethane	3	0.17 U	0.17 U	0.17 U	0.17 U
Trichloroethene	1	0.18 U	0.18 U	0.18 U	0.18 U
Vinyl chloride	1	0.21 U	0.21 U	0.21 U	0.21 U
Xylene (total)	1000	0.39 U	0.39 U	0.39 U	0.39 U
TOTAL TARGETED GC/MS Volatiles (ppb)		0.3	0	12.8	12.8
Total TIC, Volatile	NS	0	0	0	0
TOTAL NON-TARGETED GC/MS Volatiles (ppb)	NS	0	0	0	0
TOTAL GC/MS Volatiles (ppb)		0.3	0	12.8	12.8

FIGURES



Source: USGS Map 2002 **Scale: Not to Scale.**

DRESDNER ROBIN Engineering, Environmental, Planning and Surveying	**Drawing title:** REGIONAL SITE LOCATION MAP	JOB NUMBER: B-904-07	DWG. NUMBER: 1
	Project: REMEDIAL ACTION WORKPLAN ABC BARREL COMPANY SITE, CAMDEN REDEVELOPMENT AGENCY		
371 WARREN STREET JERSEY CITY, NEW JERSEY 07302 (201) 217-9200	**Location:** 308-322 NORTH FRONT STREET AND 320 NORTH 2ND STREET CAMDEN, CAMDEN COUNTY, NEW JERSEY	DATE: 11/09/11	



LEGEND

Block and Lot Boundary

Property Line (Based on 2007 Camden County Parcel Map)

Lot Boundary

SOURCES:
1. AERIAL PHOTOGRAPH: NJ HIGH RESOLUTION ORTHOPHOTOGRAPHY, 2007-08.
2. PARCEL MAP: STATE OF NEW JERSEY OFFICE OF INFORMATION TECHNOLOGY (NJOIT) & OFFICE OF GIS (OGIS), 2008-2010.

100 50 0 100

GRAPHIC SCALE
(IN FEET)

PROJECT:
REMEDIAL ACTION WORKPLAN
ABC BARREL COMPANY SITE,
CAMDEN REDEVELOPMENT AGENCY

LOCATION:
308-322 NORTH FRONT STREET
AND 320 NORTH 2nd STREET,
CAMDEN, CAMDEN COUNTY , NEW JERSEY

DRAWING TITLE:
AERIAL PHOTOGRAPH OF SITE

DRESDNER ROBIN
Engineering, Environmental, Planning and Surveying
371 WARREN STREET, JERSEY CITY, NEW JERSEY, 07302

DRAWN BY:	GG	JOB NUMBER:	Q:/Env.Manage.Group/B-904-07
CHECKED BY:	RG	FILE:	/Figures
DATE:	11/07/11	DWG. NUMBER:	2
SCALE:	AS SHOWN		

LEGEND

- Block Boundary
- Property Line
- Former Building
- AOC — Area of Concern
- Existing Monitoring Well
- Confirmation Monitoring Well, installed Oct. 2008
- Former Groundwater Screening Location, Sept. 9, 2007

SOURCES:
1. AERIAL PHOTOGRAPH: STATE OF NJ HIGH RESOLUTION ORTHOPHOTOGRAPHY, 2007-2008.
2. PARCEL MAP: STATE OF NEW JERSEY OFFICE OF INFORMATION TECHNOLOGY (NJOIT) & OFFICE OF GIS (OGIS), 2008-2010.
3. BASE MAP FROM REMINGTON & VERNICK, REMEDIAL INVESTIGATION REPORT: AABCO STEEL DRUM INC., OCTOBER 2002.

AREA OF CONCERN

No.:	DESCRIPTION	LOCATION
AOC B1	8,000- Gal. Diesel UST & Piping	NE Side of Bldg. #2
AOC B2	1,000-Gal. Fuel Oil UST & Piping	NE Side of Bldg. #2
AOC B3	1,000-Gal. Liquid Waste UST	Adjacent to Bldg. 1
AOC C		
AOC C1	Caustic Wash Area/Pipe Run/ Concrete Pit Area	Inside Bldg. #1
AOC C2	Drum Rinse Area /Pipe Run/Sediments/Concrete Pit Area	Inside Bldg. #1
AOC C3	Drum Rinse Area /Concrete Pit Area	Inside Bldg. #1
AOC C4	Caustic Wash Area /Sediments/ Concrete Pit Area	Inside Bldg. #1
AOC C5	Drum Rinse Area/Sediments/ Concrete Pit Area	Inside Bldg. #1
AOC C6	Pit Area	Inside Bldg. #2
AOCs D & K		
AOC D1	Loading/Off Loading Area	Bldg. #1/near 2nd Street
AOC D2	Loading/Off Loading Area	Bldg. #1/Southwest side
AOC D3	Loading/Off Loading Area	Bldg. #2 /adjacent to AOC B1
AOCs E & M	Drum Storage/Yard Area	Various locations west of Bldg.. #1 & 2
AOC G	Floor Drain/Trench/Piping	Along south side of Bldg. #1
AOC I	Underground Piping	South of Bldg. #1
AOC O	Oil Water Separator & Assoc. Piping	Yard adjacent to Bldg. #1
AOC P		
AOC P1	Elevator Pit	Bldg. #1/southwest side
AOC P2	Elevator Pit	Bldg. #1/northeast side
N/A	Historic Fill (see Note 1)	Entire Site (0 to 12 ft. deep)

MW-4 Coordinates
E 316939.521
N 407063.525

40 20 0 40
GRAPHIC SCALE
(IN FEET)

PROJECT:
REMEDIAL ACTION WORKPLAN
ABC BARREL COMPANY SITE,
CAMDEN REDEVELOPMENT AGENCY

LOCATION:
308-322 NORTH FRONT STREET
AND 320 NORTH 2nd STREET,
CAMDEN, CAMDEN COUNTY , NEW JERSEY

DRAWING TITLE:
Site Plan/Historic Areas of Concern

DRESDNER ROBIN
Engineering, Environmental, Planning and Surveying
371 WARREN STREET, JERSEY CITY, NEW JERSEY, 07302

DRAWN BY:	GG	JOB NUMBER:	Q:/Env.Manage.Group/B-904-03
CHECKED BY:	RG	FILE:	/Figures
DATE:	11/07/11	DWG. NUMBER:	3
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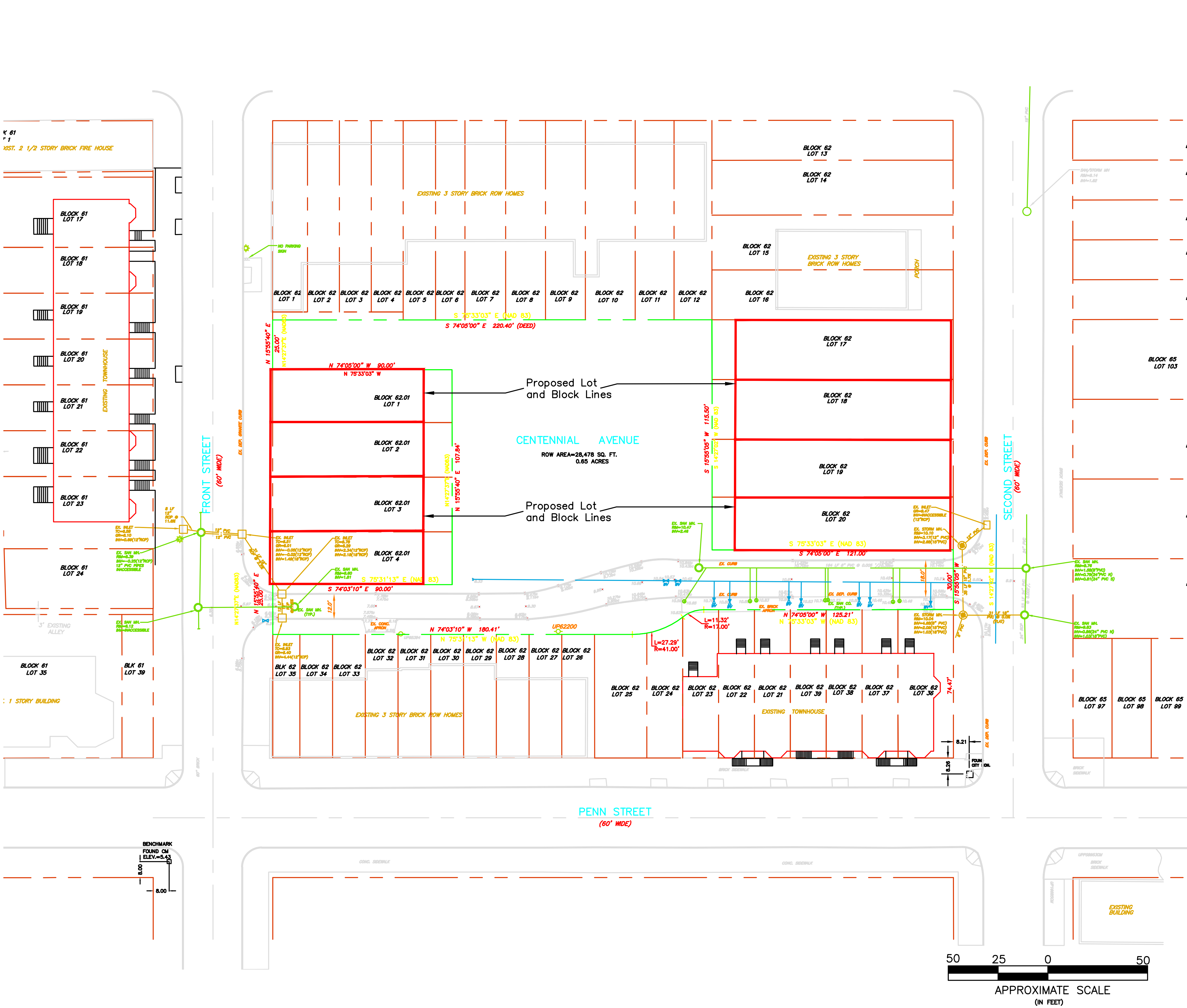


NOTES:

1) EXISTING CONDITIONS SHOWN HEREON ARE BASED ON A FIELD SURVEY PERFORMED BY CONSULTING ENGINEER SERVICES IN 8/22/08.

2) LOCATION OF UTILITIES BASED ON THE FOLLOWING INFORMATION:

   A) PLAN ENTITLED "UTILITY PLAN" COOPER GRANT HOMES by PENNROSE PROPERTIES, PLATE 11, BLOCK 57, LOTS 48, 49–51, 54–58 & 61–63; PLATE 12, BLOCK 61, LOTS 17 & 27–30; BLOCK 62, LOTS 21,22,23,38 & 45 CITY OF CAMDEN, CAMDEN COUNTY, NEW JERSEY. PLAN PREPARED BY CONSULTING ENGINEER SERVICES DATED 10/10/03, LAST REVISED 4/12/07.

   B) FIELD LOCATION SURFACE STRUCTURES

3) LOCATIONS OF UNDERGROUND UTILITIES/STRUCTURES MAY VARY FROM LOCATIONS SHOWN HEREON; WHEREAS ADDITIONAL BURIED UTILITIES/STRUCTURES MAY BE ENCOUNTERED. NO EXCAVATIONS WERE MADE DURING THE PROGRESS OF PREPARING THIS SURVEY TO LOCATE BURIED UTILITIES OF STRUCTURES. BEFORE EXCAVATIONS ARE BEGUN, THE UNDERGROUND UTILITIES LOCATION SERVICE AT 1–800–272–1000 SHALL BE CONTACTED AT LEAST 72 HOURS PRIOR TO COMMENCEMENT OF ANY DEMOLITION OR EXCAVATION ACTIVITIES, IN ACCORDANCE WITH APPLICABLE LAWS, RULES AND REGULATIONS.

4) THE RIGHT–OF–WAY IS BASED ON THE FOLLOWING INFORMATION:

   A) PLAN ENTITLED "PLAN OF MAJOR SUBDIVISION" COOPER GRANT HOMES, PLATE 11, BLOCK 57, LOTS 48, 49–51, 54–58 & 61–63; PLATE 12, BLOCK 61, LOTS 17 & 27–30; BLOCK 62, LOTS 21,22,23,38 & 45 CITY OF CAMDEN, CAMDEN COUNTY, NEW JERSEY. PLAN PREPARED BY CONSULTING ENGINEER SERVICES DATED 10/10/03, LAST REVISED 8/24/06.

   B) FOUND LOCAL MONUMENTATION AT THE TIME OF FIELD SURVEY.

5) HORIZONTAL DATUM NAD 83 IS BASED ON GPS OBSERVATION AND OPUS CALCULATIONS

6) PROPOSED LOT AND BLOCK CHANGES WERE APPROXIMATED BY DRESDNER ROBIN ON OCTOBER 10, 2011 FOR REMEDIAL DESIGN PURPOSES. FINAL LOT AND BLOCK CHANGES TO BE MADE BY CAMDEN COUNTY.

PROJECT:
REMEDIAL ACTION WORKPLAN
ABC BARREL COMPANY SITE
CAMDEN REDEVELOPMENT AGENCY

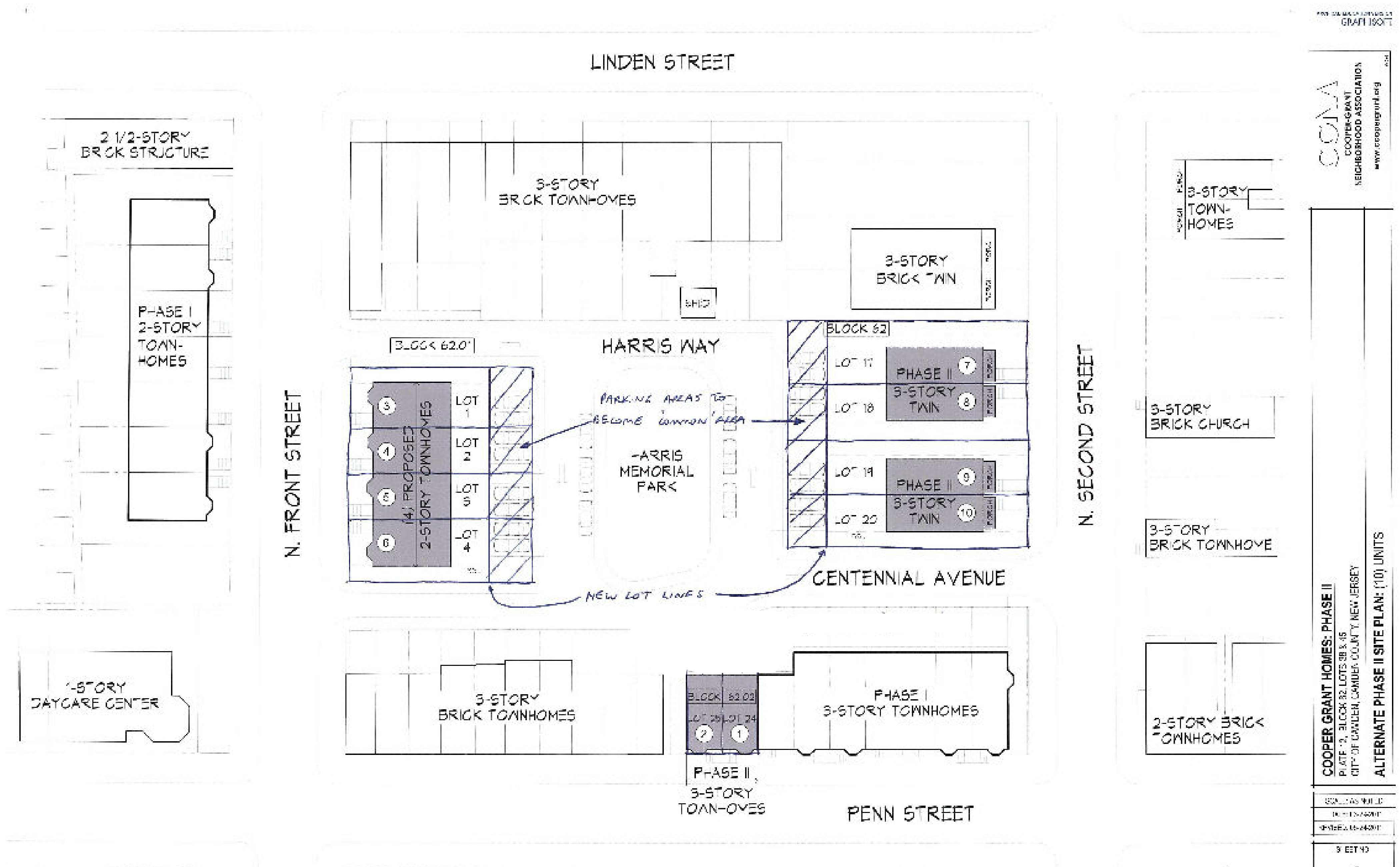
LOCATION:
308-322 NORTH FRONT STREET
AND 320 NORTH 2ND STREET
CAMDEN, CAMDEN COUNTY, NEW JERSEY

DRAWING TITLE:

Modified As-Built Site Plan

DRESDNER ROBIN
371 WARREN STREET, JERSEY CITY, NEW JERSEY, 07302

DRAWN BY: GG	JOB NUMBER: B904-07
CHECKED BY: RG	FILE:
DATE: 09/06/11	DWG. NUMBER: 4
SCALE: AS NOTED	



ALTERNATE 10 UNIT PLAN

N

SOURCE: CGNA ALTERNATE PHASE II SITE PLAN, REVISED 05-24-11

PROJECT:

REMEDIAL ACTION WORKPLAN
ABC BARREL COMPANY SITE,
CAMDEN REDEVELOPMENT AGENCY

LOCATION:

308-322 NORTH FRONT STREET
AND 320 NORTH 2ND STREET
CAMDEN, CAMDEN COUNTY, NEW JERSEY

DRAWING TITLE:

SITE DEVELOPMENT PLAN -
COOPER GRANT HOMES PHASE II

DRESDNER ROBIN
371 WARREN STREET, JERSEY CITY, NEW JERSEY, 07302

DRAWN BY: N.K.	JOB NUMBER: B-904-07
CHECKED BY: R.G	FILE: FIG5
DATE: 09/06/11	DWG. NUMBER: 5
SCALE: NOT TO SCALE	

SOURCE: NJ HIGH RESOLUTION ORTHOPHOTOGRAPHY 2007-2008, STATE OF NJ COMPOSITE PARCEL DATA 2008-2010

LEGEND

- Block Boundary
- Property Line
- Former Building
- AOC — Area of Concern

Area of Concern - Excavation Area	REPSG AOC No.	Description
AOC-B1	AOC-004	8,000-Gal. Diesel UST & Piping
AOC-B3	AOC-005	1,000-Gal. Liquid Waste UST
AOC-C1-C5	AOC-002	Drum Rinsing Area (Bldg. No. 1)
AOC-C6	AOC-003	Concrete Pit Area (Bldg. No. 2)
AOC-G	AOC-006	Floor Drain/Trench/Piping Area
AOC-O	AOC-001	Oil Water Separator & Piping

SOURCES:
1. EXCAVATION AREAS:
COOPER GRANT PROJECT; FRONT STREET, CAMDEN, NJ; PROJECT NO. 7254-002; REACT ENVIRONMENTAL SERVICE GROUP, INC., MAY 2006
2. AERIAL PHOTOGRAPH:NJ HIGH RESOLUTION PHOTOGRPAHY, 2007-08.
3. PARCEL MAP: STATE OF NEW JERSEY OFFICE OF INFORMATION TECHNOLOGY (NJOIT) & OFFICE OF GIS (OGIS), 2008-10.
4. BASE MAP FROM REMINGTON & VERNICK, REMEDIAL INVESTIGATION REPORT: AABCO STEEL DRUM INC., OCTOBER 2002.

40 20 0 40
GRAPHIC SCALE
(IN FEET)

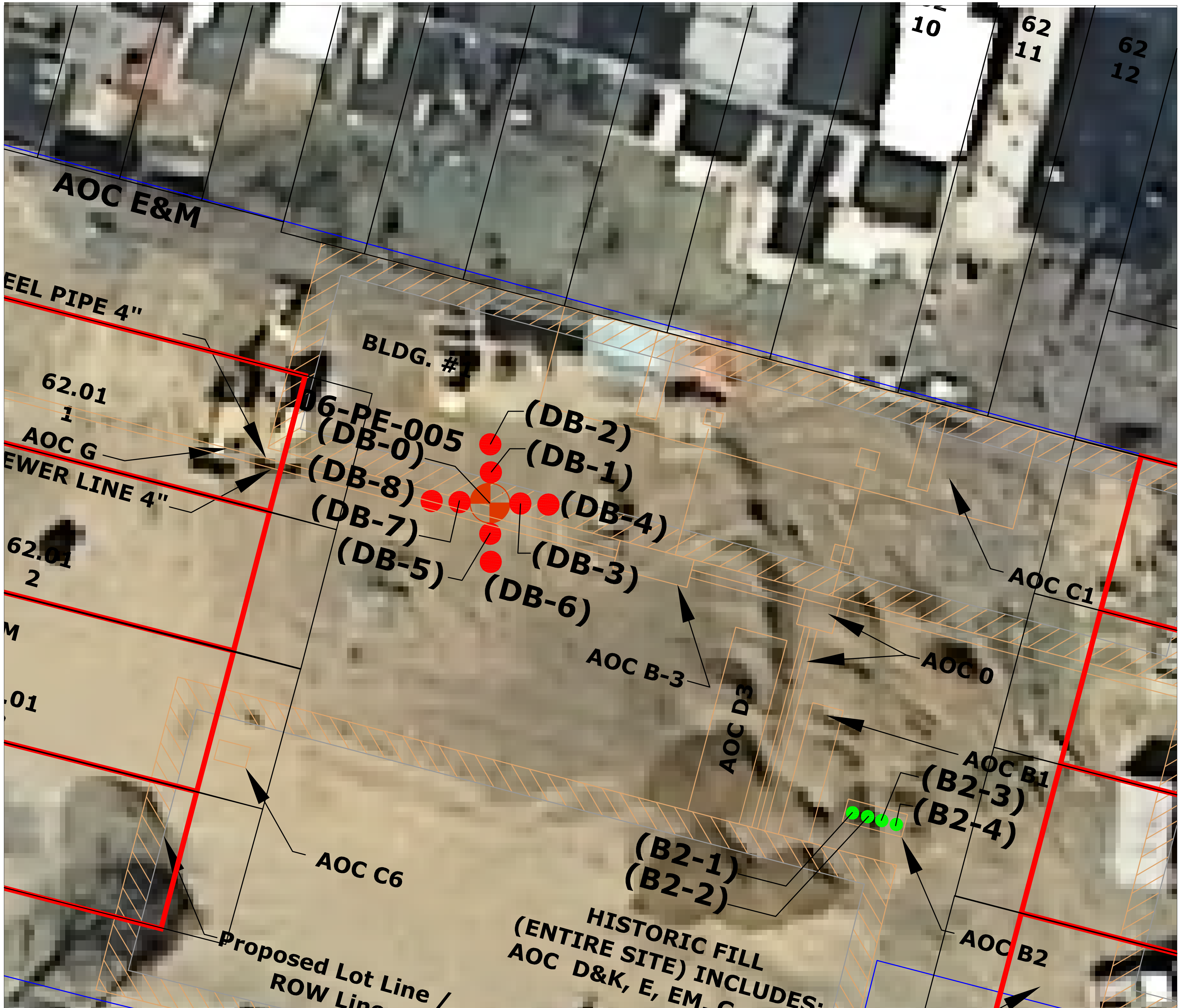
PROJECT:
REMEDIAL ACTION WORKPLAN
ABC BARREL COMPANY SITE
CAMDEN REDEVELOPMENT AGENCY

LOCATION:
308-322 NORTH FRONT STREET
AND 320 NORTH 2ND STREET
CAMDEN, CAMDEN COUNTY, NEW JERSEY

DRAWING TITLE:
RECORD OF HISTORIC REMEDIAL ACTIONS
(MARCH 2006)

DRESDNER ROBIN
Engineering • Environmental • Planning • Surveying • Landscape Architecture
371 WARREN STREET, JERSEY CITY, NEW JERSEY, 07302

DRAWN BY: GG	JOB NUMBER: B904-07
CHECKED BY: RG	FILE:
DATE: 09/06/11	DWG. NUMBER: 6
SCALE: AS NOTED	



LEGEND

- Block Boundary
- Property Line
- Former Building
- Proposed Lots
- **AOC** Area of Concern
- AOC-G - Former Trench Area - Post Excavation Soil Sample with Trichloroethene (PCE) Exceeding the New Jersey Soil Remediation Standard
- Proposed Soil Delineation Borings and Samples
- AOC-B2 - Former 1000-Gallon Fuel Oil UST Proposed Soil Characterization Boring/Sample Location

NOTES:

SOURCES:
1. AERIAL PHOTOGRAPH: NJ HIGH RESOLUTION PHOTOGRPAHY, 2007–08.
2. PARCEL MAP: STATE OF NEW JERSEY OFFICE OF INFORMATION TECHNOLOGY (NJOIT) & OFFICE OF GIS (OGIS), 2008–10.
3. BASE MAP FROM REMINGTON & VERNICK, REMEDIAL INVESTIGATION REPORT: AABCO STEEL DRUM INC., OCTOBER 2002.

20 10 0 20

GRAPHIC SCALE
(IN FEET)

PROJECT:
REMEDIAL ACTION WORKPLAN
ABC BARREL COMPANY SITE
CAMDEN REDEVELOPMENT AGENCY

LOCATION:
308-322 NORTH FRONT STREET
AND 320 NORTH 2ND STREET
CAMDEN, CAMDEN COUNTY, NEW JERSEY

DRAWING TITLE:
Soil Characterization/Delineation
Sampling Location Plan

DRESDNER ROBIN
371 WARREN STREET, JERSEY CITY, NEW JERSEY, 07302

DRAWN BY: GG	JOB NUMBER: B904-07
CHECKED BY: RG	FILE:
DATE: 09/06/11	DWG. NUMBER: 7
SCALE: AS NOTED	

LEGEND

- Existing Block Boundary
- Proposed Property Line
- Existing Lot Boundary
- Proposed Lots
- **AOC** Area of Concern
- **B1-1** Residential Lot Soil Characterization Borings for Waste Classification (0-12 ft)
- **ROW-1** ROW Soil Characterization Borings for Waste Classification (0-1ft)

SOURCES:
1. AERIAL PHOTOGRAPH: NJ HIGH RESOLUTION PHOTOGRPAHY, 2007–08.
2. PARCEL MAP: STATE OF NEW JERSEY OFFICE OF INFORMATION TECHNOLOGY (NJOIT) & OFFICE OF GIS (OGIS), 2008–10.
3. BASE MAP FROM REMINGTON & VERNICK, REMEDIAL INVESTIGATION REPORT: AABCO STEEL DRUM INC., OCTOBER 2002.

NOTES:

1. In the residential lot borings, one sample will be collected from each of the following intervals: A interval 0-3 ft; B interval 3-6 ft; C interval 6-9 ft; and D interval 9-12 ft. (See table in RAW for sample analysis).

2. In the ROW borings, one sample will be collected from each boring from the 0-1 ft interval.

3. Number of samples is based upon one (1) grab sample per 180 tons of soil.

50 25 0 50

GRAPHIC SCALE
(IN FEET)

PROJECT:
REMEDIAL ACTION WORKPLAN
ABC BARREL COMPANY SITE
CAMDEN REDEVELOPMENT AGENCY

LOCATION:
308-322 NORTH FRONT STREET
AND 320 NORTH 2ND STREET
CAMDEN, CAMDEN COUNTY, NEW JERSEY

DRAWING TITLE:
Waste Characterization Sampling Location Plan

DRESDNER ROBIN
Engineering • Environmental • Planning • Surveying • Landscape Architecture
371 WARREN STREET, JERSEY CITY, NEW JERSEY, 07302

DRAWN BY: GG	JOB NUMBER: B904–07
CHECKED BY: RG	FILE: Q\Env.ManagementGroup\B904–07 CRA–ABC Barrel\Raw\Figures
DATE: 09/06/11	DWG. NUMBER: 8
SCALE: AS NOTED	

Sample ID: D22 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	540
	Benzo(a)anthracene	0.6	2	1.2
	Benzo(b)fluoranthene	0.6	2	0.8
	Benzo(a)pyrene	0.2	0.2	0.99
	Dibenzo(a,h)anthracene	0.2	0.2	0.31

Sample ID: D13 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	890
	Benzo(a)anthracene	0.6	2	5.2
	Benzo(b)fluoranthene	0.6	2	4
	Benzo(a)pyrene	0.2	0.2	4.3
	Indeno(1,2,3-cd)pyrene	0.6	2	2.1

Sample ID: D10 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Benzo(a)anthracene	0.6	2	10
	Benzo(b)fluoranthene	0.6	2	9.8
	Benzo(k)fluoranthene	6	23	6.2
	Benzo(a)pyrene	0.2	0.2	8.5
	Indeno(1,2,3-cd)pyrene	0.6	2	3.6
	Dibenzo(a,h)anthracene	0.2	0.2	2.2

Sample ID: D9 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	452
	Benzo(a)anthracene	0.6	2	13
	Benzo(b)fluoranthene	0.6	2	12
	Benzo(k)fluoranthene	6	23	8.6
	Benzo(a)pyrene	0.2	0.2	11
	Indeno(1,2,3-cd)pyrene	0.6	2	4.4
	Dibenzo(a,h)anthracene	0.2	0.2	2.8

Sample ID: D7 (0 - 6")	Analyte	NJDEP (mg/kg)	NJDEP (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	911

Sample ID: D8 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	7840
	Mercury	23	65	947
	Benzo(a)anthracene	0.6	2	1.3
	Benzo(b)fluoranthene	0.6	2	1.3
	Benzo(a)pyrene	0.2	0.2	0.94
	Dibenzo(a,h)anthracene	0.2	0.2	0.33

Sample ID: D6 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	812
	Benzo(a)anthracene	0.6	2	10
	Benzo(b)fluoranthene	0.6	2	9.6
	Benzo(k)fluoranthene	6	23	8.4
	Benzo(a)pyrene	0.2	0.2	7.9
	Indeno(1,2,3-cd)pyrene	0.6	2	1
	Dibenzo(a,h)anthracene	0.2	0.2	2.5

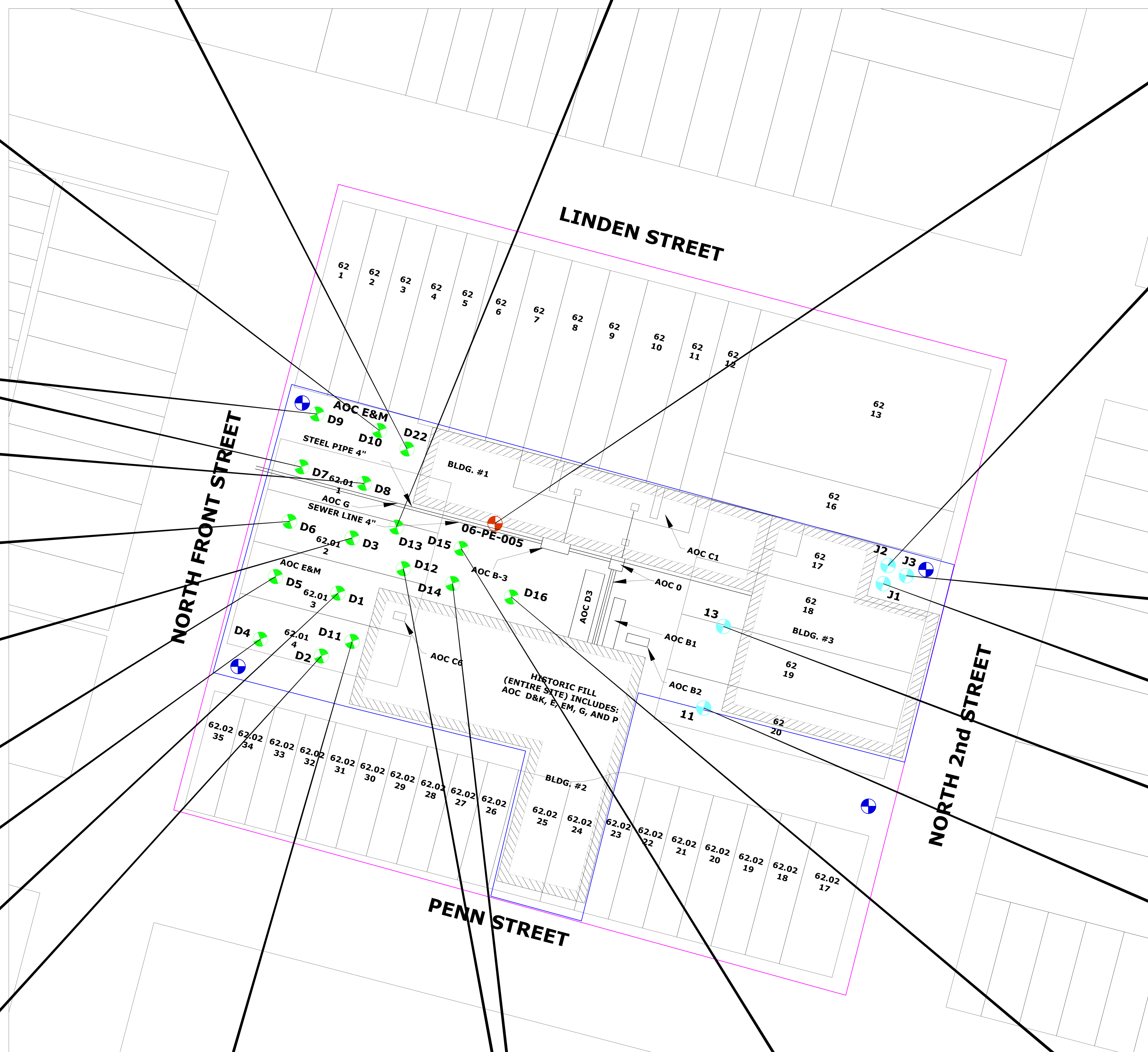
Sample ID: D3 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	500
	Benzo(a)anthracene	0.6	2	5
	Benzo(b)fluoranthene	0.6	2	5
	Benzo(k)fluoranthene	6	23	3.7
	Benzo(a)pyrene	0.2	0.2	4.5
	Indeno(1,2,3-cd)pyrene	0.6	2	2.1
	Dibenzo(a,h)anthracene	0.2	0.2	1.3

Sample ID: D5 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Benzo(a)anthracene	0.6	2	13
	Benzo(b)fluoranthene	0.6	2	11
	Benzo(k)fluoranthene	6	23	9.4
	Benzo(a)pyrene	0.2	0.2	12
	Indeno(1,2,3-cd)pyrene	0.6	2	7.4
	Dibenzo(a,h)anthracene	0.2	0.2	1.9

Sample ID: D4 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Benzo(a)anthracene	0.6	2	0.71
	Benzo(a)pyrene	0.2	0.2	0.49
	Heptachlor	0.1	0.7	22

Sample ID: D1 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	1560
	Benzo(a)anthracene	0.6	2	10
	Benzo(b)fluoranthene	0.6	2	9.6
	Benzo(k)fluoranthene	6	23	8.4
	Benzo(a)pyrene	0.2	0.2	7.9
	Indeno(1,2,3-cd)pyrene	0.6	2	1
	Dibenzo(a,h)anthracene	0.2	0.2	2.5

Sample ID: D2 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Cadmium	78	78	106
	Lead	400	800	636
	Benzo(a)anthracene	0.6	2	21
	Benzo(b)fluoranthene	0.6	2	19
	Benzo(k)fluoranthene	0.6	2	11
	Benzo(a)pyrene	0.2	0.2	16
	Indeno(1,2,3-cd)pyrene	0.6	2	7.5
	Dibenzo(a,h)anthracene	0.2	0.2	4.3



Sample ID: 06PE-005 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
Date: 03/31/2006	Lead	400	800	790
	Benzo(a)anthracene	0.6	2	440
	Benzo(a)pyrene	0.2	0.2	220
	Benzo(b)fluoranthene	0.6	2	470
	Benzo(k)fluoranthene	6	23	610
	Chrysene	62	230	460
	Indeno(1,2,3-cd)pyrene	0.6	2	330
	Tetrachloroethene	2	5	520D*
	D*: Dilution required for sample			

Sample ID: J2 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC D1	Benzo(a)anthracene	0.6	2	0.92
	Benzo(b)fluoranthene	0.6	2	0.87
	Benzo(a)pyrene	0.2	0.2	0.77
	Dibenzo(a,h)anthracene	0.2	0.2	0.22

Sample ID: J3 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC D1	Benzo(a)anthracene	0.6	2	0.83
	Benzo(b)fluoranthene	0.6	2	0.85
	Benzo(a)pyrene	0.2	0.2	0.74
	Dibenzo(a,h)anthracene	0.2	0.2	0.2

Sample ID: J1 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC D1	Benzo(a)anthracene	0.6	2	14
	Benzo(b)fluoranthene	0.6	2	15
	Benzo(k)fluoranthene	6	23	8.4
	Benzo(a)pyrene	0.2	0.2	12
	Indeno(1,2,3-cd)pyrene	0.6	2	5.7
	Dibenzo(a,h)anthracene	0.2	0.2	3.5

Sample ID: 13 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC D2	Lead	400	800	955
	Benzo(a)anthracene	0.6	2	6.7
	Benzo(b)fluoranthene	0.6	2	4.5
	Benzo(a)pyrene	0.2	0.2	5.1
	Indeno(1,2,3-cd)pyrene	0.6	2	2.2
	Dibenzo(a,h)anthracene	0.2	0.2	1.4

Sample ID: 11 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC D2	Benzo(a)anthracene	0.6	2	1.7
	Benzo(b)fluoranthene	0.6	2	1.4
	Benzo(a)pyrene	0.2	0.2	1.4
	Dibenzo(a,h)anthracene	0.2	0.2	0.4
	Indeno(1,2,3-cd)pyrene	0.6	2	0.64

Sample ID: D11 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	411
	Benzo(a)anthracene	0.6	2	6.2
	Benzo(b)fluoranthene	0.6	2	4.8
	Benzo(a)pyrene	0.2	0.2	5.1
	Indeno(1,2,3-cd)pyrene	0.6	2	2.2
	Dibenzo(a,h)anthracene	0.2	0.2	1.4

Sample ID: D12 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	808
	Arsenic	19	19	44.2
	Copper	3100	45000	8770
	Benzo(a)anthracene	0.6	2	7.3
	Benzo(b)fluoranthene	0.6	2	7
	Benzo(k)fluoranthene	0.6	2	6.8
	Benzo(a)pyrene	0.2	0.2	7.2
	Indeno(1,2,3-cd)pyrene	0.6	2	4.7
	Dibenzo(a,h)anthracene	0.2	0.2	2.6

Sample ID: D14 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	1190
	Benzo(a)anthracene	0.6	2	0.88
	Benzo(b)fluoranthene	0.6	2	0.88
	Benzo(a)pyrene	0.2	0.2	0.75
	Dibenzo(a,h)anthracene	0.2	0.2	0.23

Sample ID: D15 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Antimony	31	450	121
	Lead	400	800	6580
	Benzo(a)anthracene	0.6	2	1.7
	Benzo(b)fluoranthene	0.6	2	1.8
	Benzo(a)pyrene	0.2	0.2	1.6
	Indeno(1,2,3-cd)pyrene	0.6	2	1.2
	Dibenzo(a,h)anthracene	0.2	0.2	0.66

Sample ID: D16 (0 - 6")	Analyte	NJDEP RDCSRS (mg/kg)	NJDEP NRDCSRS (mg/kg)	Contaminant Concentration (mg/kg)
AOC E	Lead	400	800	750
	Arsenic	19	19	24
	Benzo(a)anthracene	0.6	2	8.6
	Benzo(b)fluoranthene	0.6	2	8.3
	Benzo(k)fluoranthene	0.6	2	8
	Benzo(a)pyrene	0.2	0.2	7.3
	Indeno(1,2,3-cd)pyrene	0.6	2	4.9
	Dibenzo(a,h)anthracene	0.2	0.2	2.5

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LEGEND

- Block Boundary *
- Property Line
- Former Building
- AOC — Area of Concern
- Historic Fill Investigation Borings Conducted By R&V on July 16, 2001 (approximate location).
- AOC D1/D2 - Loading/Off Loading Area Existing Soil Characterization Borings Conducted By R&V on October 13, 1997.
- AOC-E - Drum Storage/Yard Area Existing Soil Characterization Borings Conducted By R&V on October 13, 1997.
- AOC-G - Former Trench/Floor Drain/Piping Area - Post Excavation Soil Samples Collected by REACT On March 31, 2006.

*NOTE: INTERNAL LOT BOUNDARIES HAVE BEEN MODIFIED FROM ORIGINAL SURVEY (SEE FIGURE 4).

NOTES

1. Soil concentration data is being provided for reference purposes only. Other contamination may be present that is not shown on the map.
2. Source of Data: "Supplemental Remediation Investigation Historic Remedial Action Report" ABC Barrel Co. Site, Dresdner Robin, July 2010.

SOURCES:
1. AERIAL PHOTOGRAPH:NJ HIGH RESOLUTION PHOTOGRPAHY, 2007-08.
2. PARCEL MAP: STATE OF NEW JERSEY OFFICE OF INFORMATION TECHNOLOGY (NJOIT) & OFFICE OF GIS (OGIS), 2008-10.
3. BASE MAP FROM REMINGTON & VERNICK, REMEDIAL INVESTIGATION REPORT: AABCO STEEL DRUM INC., OCTOBER 2002.

PROJECT:

Remedial Investigation
ABC Barrel Company Site
Camden Redevelopment Agency
Remedial Action Workplan

LOCATION:

308-322 NORTH FRONT STREET
AND 320 NORTH 2ND STREET
CAMDEN, CAMDEN COUNTY, NEW JERSEY

DRAWING TITLE:

Environmental Plan Sheet 1 of 2
Soil Contaminant Distribution Map

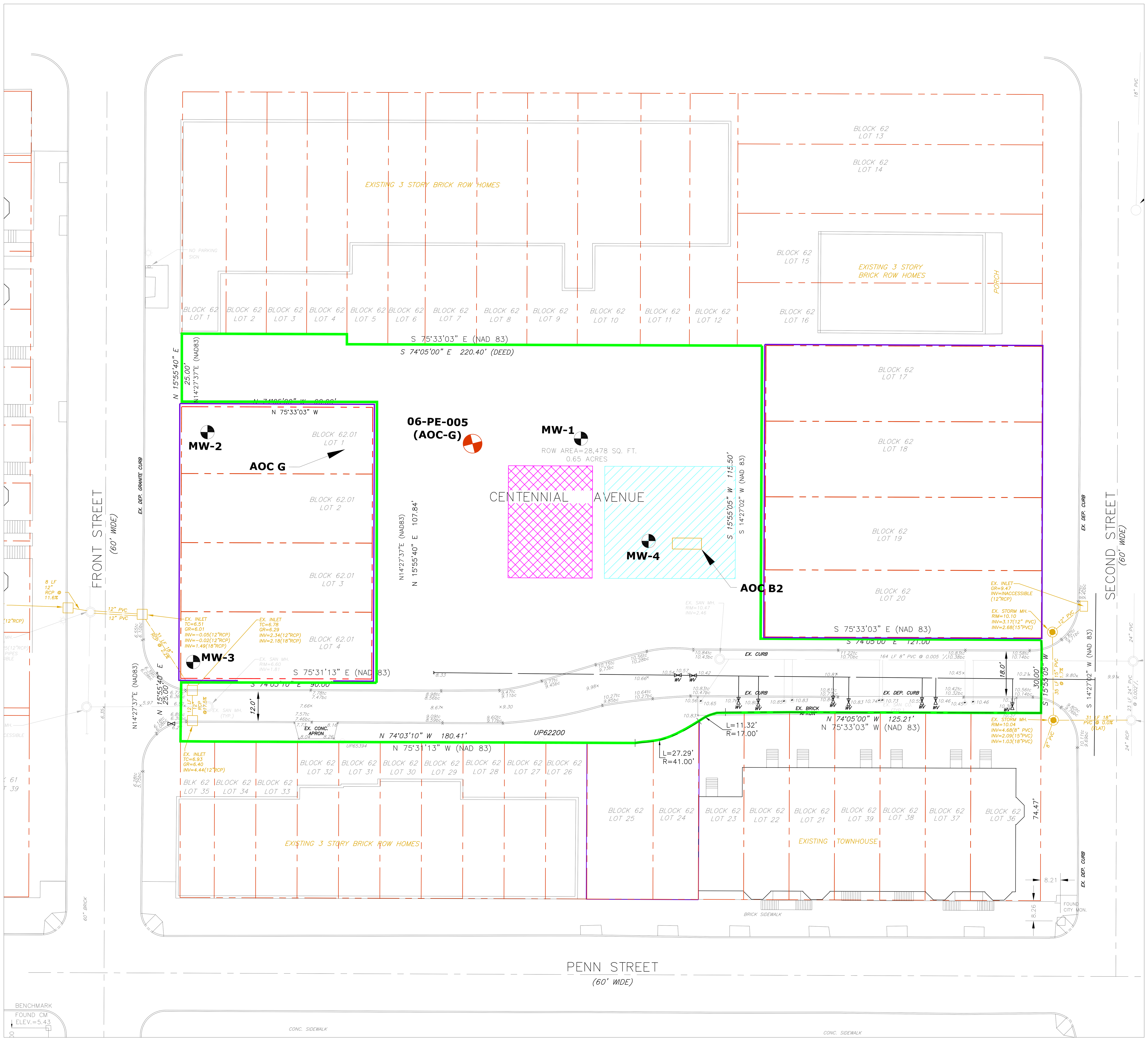
DRESDNER ROBIN
371 WARREN STREET
JERSEY CITY, NJ 07302
(TEL) 201.217.9200 (FAX) 201.217.9607
CERTIFICATE OF AUTHORIZATION # - 24GA27926000

GRAPHIC SCALE:
30 15 0 30
GRAPHIC SCALE (IN FEET)

DRAWN BY: GG	CHECKED BY: RG	DRAWING NUMBER: 9
SCALE: AS NOTED	DATE: 09.12.11	
JOB No. 904-07		

Q:\ENV\ENV. MANAGE. GROUP\B904-07 CRA - ABC BARREL RAW\FIGURES\FIG 9 ENVIRONMENTAL PLAN 1.DWG

DUE TO INHERENT ERRORS IN REPRODUCTION METHODS, ERRORS MAY OCCUR WHEN SCALING THIS DRAWING



NOTES

1. The work involves the remediation of Historic Fill defined as any fill material comprised entirely or in part of non-native materials and exhibiting levels of contamination consitstant with those reported in N.J.A.C.-7:26E, Appendix D "Historic Fill Data Base Summary Table". Historic Fill Materials were found to underlie the entire Site; the distribution of contamination in the historic fill exceeding the most stringent New Jersey Soil Remediation Standards based upon historic site data is shown on Sheet 1 of the Environmental Plan.

2. The contractor shall provide all labor, materials, equipment, temporary structures and permits necessary for the removal and disposal of existing onsite vegetation (i.e. shrubs and trees) and the excavation and handling, waste classification, and transport and disposal of Historic Fill and Backfilling of the excavation with compacted, certified clean fill in accordance with Section 1 of the Technical Specifications (Specifications) and as shown on Environmental Plan Sheet 2.

3. The contractor shall provide all labor, materials and equipment to protect worker health and safety during the site remediation activities; the contractor will prepare, implement, and execute a site-specific Health and Safety Plan (HASP), which addresses worker protection and the protection of the public health and safety, during the site remediation activities as described in Section 2 of the Specifications.

4. The contractor shall provide and implement measures to suppress airborne soil particulates; if necessary the contractor shall provide and apply clean soil and/or commercially manufactured absorbent or masking materials/systems to control odors; the contractor shall also monitor the emission of odors and particulate from the work site in compliance with the Contractor's approved Health and Safety Plan, in accordance with Section 3 of the Specifications.

5. The contractor shall provide all related materials, equipment, and labor to conduct all soil disturbing operations in accordance with all applicable soil erosion control statutes, regulations and standards of practice; prepare all plans and obtain all approvals as required to implement the HASP and Soil Erosion and Sediment Control Plan measures; and furnish and construct all control measures required by approved plans as specified in Section 4 of the Specifications.

6. The contractor shall supply all necessary materials, equipment, and labor for the collection, storage, and control of storm water runoff or subsurface seepage into excavated areas in accordance with Section 5 of the Specifications and as specified on Sheet 2 of the Environmental Plan. The contractor shall provide a brief site-specific *Pollution Prevention and Control Plan* for the handling, collection, storage and control of contaminated groundwater, storm water runoff, decant liquids, decontamination fluids, and accidental spills and leaks of hazardous liquids within work areas.

7. The contractor shall excavate an infiltration basin at the location shown on Sheet 2 of the Environmental Plan for the purpose of recharging contaminated liquids pumped from the excavation during construction dewatering activities. The contractor will treat the pumped water by use of an oil-water separator as necessary to remove petroleum product (i.e. , sheen), and shall remove suspended sediments from the discharge waters prior to on-site recharge. The client or his representative shall obtain a NJPDES Permit-by-Rule Authorization to allow permitted recharge at the site. The contractor shall comply with all requirements of the Permit-by-Rule Authorization obtained for the project.

8. Following removal of the Historic Fill/contaminated soil described in Section 1 of the Specifications, the contractor shall is required to supply and place certified clean backfill within the excavation, in compacted lifts, up to the existing grade or as determined by the Client's Representative. The work includes providing certification to the Client that certified clean fill imported to the site is free of contaminants in accordance with applicable regulations and as specified in Section 6 of the Specifications.

9. The contractor shall provide all labor, material, and equipment to remove and dispose of existing onsite vegetation (i.e. shrubs and trees); excavate Historic Fill/contaminated soil; place and compact certified clean backfill after excavation, in accordance with section 7 of the Specifications and as shown on Sheet 2 of the Environmental Plan.

10. The contractor shall, in accordance with applicable Federal, State, County and local rules, regulations and guidelines and as required by section 8 of the Specification, prepare all necessary plans, obtain all permits, licenses, and approvals and furnish all labor, materials, tools, equipment, analytical test, and temporary works required to provide for the safe excavation, handling, transportation, and disposal of contaminated soil and materials (regulated, non-hazardous and hazardous waste).

11. The contractor shall abandon all existing Monitoring Wells (MW-1, MW-2, MW-3 and MW-4) in accordance with N.J.A.C. 7:9D prior to start of excavation activities. The contractor shall utilize a NJ Certified Well Driller to conduct this work. Monitoring well locations are shown on Environmental Plan Sheet 2 of 2.

12. The contractor shall conduct soil characterization and delineation sampling of AOC-G (former trench/piping area) and AOC-B2 (former 1,000 gallon No.-2 fuel oil UST) at the locations shown on Environmental Plan Sheet 2 of 2. The work shall be performed in accordance with N.J.A.C. 7:26E-3.6 and 4.3 and the ABC Barrel Company Remedial Action Workplan/SAMP (Dresdner Robin, November 2011). Following completion of the characterization/delineation sampling, the contractor shall excavate and dispose all contaminated soils found to exceed the NJDEP Soil Remediation Standards (See Notes 2, 3, 6 and 8 above for work requirements).

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PENNSAUKEN, NJ 08109
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LEGEND

- Proposed Block and Lot Lines
- Areas of Historic Fill Material Requiring Excavation and off Site Disposal (+/- 0 to 12 ft bgs) and Backfill with Clean Certified Fill Materials
- Areas of Historic Fill Material Requiring Excavation and off Site Disposal (+/- 0 to 1 ft bgs) and Construction of Engineering Cap with Clean Certified Fill Materials
- Infiltration Basin Area for On-Site Management of Contaminated Liquids
- Staging/Stockpile Area for Contaminated Materials
- Existing Site Monitoring Well
- 1,000 gallon fuel oil tank excavation area requiring characterization/delineation sampling and contaminated soil removal if necessary
- AOC-G - Former Trench/Piping Area with sample (06-PE-005) requiring delineation and removal of contaminated soil

*NOTE: INTERNAL LOT BOUNDARIES HAVE BEEN MODIFIED FROM ORIGINAL SURVEY (SEE FIGURE 4)

PROJECT:

Remedial Investigation
ABC Barrel Company Site
Camden Redevelopment Agency
Remedial Action Workplan

LOCATION:

308-322 NORTH FRONT STREET
AND 320 NORTH 2ND STREET
CAMDEN, CAMDEN COUNTY, NEW JERSEY

DRAWING TITLE:

Environmental Plans Sheet 2 of 2
Regulated Waste Excavation Areas

DRESDNER ROBIN
371 WARREN STREET
JERSEY CITY, NJ 07302
(TEL) 201.217.9200 (FAX) 201.217.9607
CERTIFICATE OF AUTHORIZATION # - 24GA27926000

GRAPHIC SCALE:

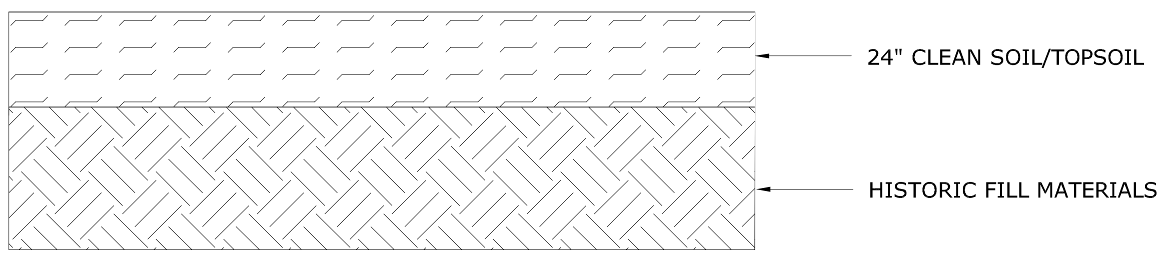
20 10 0 20
GRAPHIC SCALE
(IN FEET)

DRAWN BY:	CHECKED BY:	DRAWING NUMBER:
GG	RG	10
SCALE: AS NOTED	DATE: 09.12.11	
JOB No. 904-07		

DUE TO INHERENT ERRORS IN REPRODUCTION METHODS, ERRORS MAY OCCUR WHEN SCALING THIS DRAWING

CAP DETAIL

NOT TO SCALE



Source: USGS Map 2002

Scale: Not to Scale.

DRESDNER ROBIN Engineering, Environmental, Planning and Surveying	**Drawing title:** ENGINEERING CAP DETAIL (PUBLIC USE/ROW)	JOB NUMBER: B-904-07	DWG. NUMBER: 11
	Project: REMEDIAL ACTION WORKPLAN ABC BARREL COMPANY SITE, CAMDEN REDEVELOPMENT AGENCY		
371 WARREN STREET JERSEY CITY, NEW JERSEY 07302 (201) 217-9200	**Location:** 308-322 NORTH FRONT STREET AND 320 NORTH 2ND STREET CAMDEN, CAMDEN COUNTY, NEW JERSEY	DATE: 11/09/11	

APPENDICES

APPENDIX A
NJDEP Correspondence

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OCT - 4 2010

PERKS-REUTTER ASSOCIATES

State of New Jersey

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Southern Field Operations
401 East State Street
P.O. Box 420
Trenton, NJ 08625-0420
Phone #: 609-633-1475
Fax #: 609-984-6004

BOB MARTIN
Commissioner

September 30, 2010

Saundra Ross Johnson, Executive Director
City of Camden
Camden Redevelopment Agency
520 Market Street, Suite 1300
Camden, NJ 08101

Re: **No Further Action Letter**
Remedial Action Type: Unrestricted Use for Ground Water
North Front Street Associates (a.k.a. ABC Barrel Co.)
308 to 322 North Front Street
Camden City, Camden County
Program Interest #: 006594
Activity Number: BFO000001
Document Title: ABC Barrel Co 950914120653
Communications Center Number: 95-09-14-1206-53
BFO File Number: 04-08-58
Block: 62 and Lots: 38 & 44
Well Permit #s: P200801109 & P200801110

Dear Ms. Ross Johnson:

Pursuant to N.J.S.A. 58:10B-13.1 and N.J.A.C. 7:26C, the New Jersey Department of Environmental Protection (Department) issues this No Further Action Letter for the remediation of the ground water specifically referenced above, so long as the City of Camden-Camden Redevelopment Agency did not withhold any information from the Department. This action is based upon information in the Department's case file and the City of Camden-Camden Redevelopment Agency's final certified report dated March 4, 2009. In issuing this No Further Action Letter, the Department has relied upon the certified representations and information provided to the Department. To remain in compliance with the terms of this No Further Action Letter, the City of Camden-Camden Redevelopment Agency as well as each subsequent owner, lessee and operator must comply with the conditions noted below.

By issuance of this No Further Action Letter, the Department acknowledges the completion of a Preliminary Assessment, Site Investigation, Remedial Investigation and Remedial Action pursuant to the Technical Requirements for Site Remediation (N.J.A.C. 7:26E) for the ground water beneath the site and no other areas.

By operation of law a Covenant Not to Sue pursuant to N.J.S.A. 58:10B-13.1 applies to this remediation. The Covenant Not to Sue is subject to any conditions and limitations contained herein. The Covenant Not to Sue remains effective only as long as the real property referenced above continues to meet the conditions of this No Further Action Letter.

NO FURTHER ACTION CONDITIONS

Pursuant to N.J.S.A. 58:10B-12o, the City of Camden-Camden Redevelopment Agency and any other person who was liable for the cleanup and removal costs, and remains liable pursuant to the Spill Act, shall inform the Department in writing within 14 calendar days whenever its name or address changes. Any notices submitted pursuant to this paragraph shall reference the above case numbers and shall be sent to: Bureau of Case Assignment and Initial Notice – Case Assignment Section, P.O. Box 434, Trenton, N.J. 08625-0434.

The City of Camden-Camden Redevelopment Agency as well as each subsequent owner, lessee and operator (collectively Successors) shall comply with each of the following:

Well Decommissioning

Pursuant to N.J.S.A. 58:4A, the City of Camden-Camden Redevelopment Agency shall properly decommission all monitoring wells installed as part of a remediation that will no longer be used for ground water monitoring. A New Jersey licensed well driller shall decommission the wells in accordance with the requirements of N.J.A.C. 7:9D-3.1 (et seq.). After the well has been decommissioned by a New Jersey licensed well driller, the well driller is required to submit a copy of the decommissioning report on your behalf to the Bureau of Water Systems and Well Permitting. Please note that only a New Jersey licensed well driller may perform this work. More information about regulations regarding the maintenance and decommissioning of wells in New Jersey can be found at http://www.nj.gov/dep/watersupply. For a list of New Jersey licensed well drillers, click on the "reports" button in the left column and select "access the well permit reports." Questions can be emailed to wellpermitting@dep.state.nj.us.

NOTICES

This No Further Action Letter is for ground water only located beneath the referenced site. The Department has relied, in part, on the reported ground water data to support that soil contamination still present on the site is no longer affecting the ground water located beneath the site. Please be advised that if changes in future ground water data no longer support this conclusion, the Department reserves it rights to require additional ground water investigation and/or remediation.

Thank you for your attention to these matters. If you have any questions, please contact Cheryl Priest at (609) 292-2723.

Sincerely,

George King, Bureau Chief
Bureau of Southern Field Operations

c: Camden County Health Department
Municipal Clerk, Camden City
Dresden Robin
BFO File # 04-08-58

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OCT - 4 2010

PERKS-REUTTER ASSOCIATES

State of New Jersey

CHRIS CHRISTIE
Governor

KIM GUADAGNO
Lt. Governor

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Southern Field Operations
401 East State Street
P.O. Box 420
Trenton, NJ 08625-0420
Phone #: 609-633-1475
Fax #: 609-984-6004

BOB MARTIN
Commissioner

September 30, 2010

Saundra Ross Johnson, Executive Director
Camden Development Agency
City Hall, 520 Market Street
Suite 1300, P.O. Box 95120
Camden, NJ 08101

Remedial Investigation Report Approval

Re: Remedial Investigation Report (Soils Only)
ABC Barrel Company Site (a.k.a. North Front St Associates)
308 to 322 North Front Street
Camden City, Camden County
SRP PI#: 006594
EA ID #: SUB100002
BFO File Number: 04-08-58

Dear Ms. Ross Johnson:

The New Jersey Department of Environmental Protection (Department) has completed review of the Remedial Investigation Report received on July 13, 2010. The Department has determined that the Remedial Investigation Report is in compliance with the Technical Requirements for Site Remediation, N.J.A.C. 7:26E and other applicable requirements. The Department hereby approves the Remedial Investigation Report and the proposal to submit a Remedial Action Workplan, effective the date of this letter.

Pursuant to the schedule applicable to the site you shall submit a Remedial Action Workplan on October 1, 2011. Please submit the document by that date, or submit a written request for an extension at least 2 weeks prior to the due date. Failure to submit the Remedial Action Workplan in accordance with the schedule may result in the initiation of enforcement action. For your convenience, the regulations concerning the Department's remediation requirements can be found at http://www.state.nj.us/dep/srp/regs/.

Thank you for your cooperation in this matter. If you have any questions, call Cheryl Priest at (609) 292-2723.

Sincerely,

William H Dunfee

William H. Dunfee, Section Chief
Bureau of Southern Field Operations

c: Dresdner Robin
Clerk, Camden City
Camden County Health Department
BFO File Number: 04-08-58
M. Deely, NJDEP-BC&FM

APPENDIX B

Soil Boring/Well Logs/Test Pit Logs

Dresdner Robin Soil Boring / Well Log MW-4, 10/07/08

Soil Boring/Well Details: MW-4

Project No: B-904-03	***Northing:*** 407060.3041	***Water Level:*** 12'
Project: ABC Barrel	***Easting:*** 316938.2953	***Sampling Method:*** Split Spoon
Client: Camden Redevelopment Agency	***Elevation:*** 12.74	***Sample Interval:*** 2'
Location: Camden, NJ	***Total Depth:*** 18'	***Logged By:*** LAM

SAMPLE

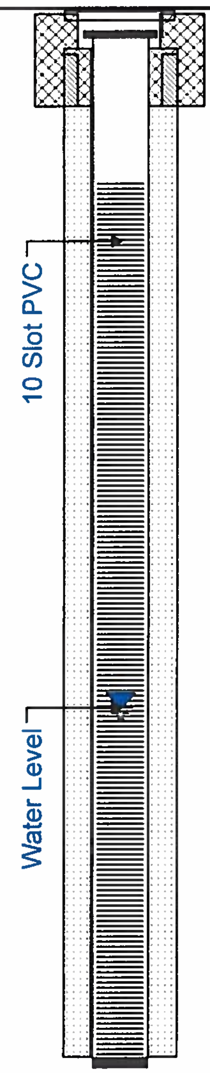
Sample #	Blow Counts	Recovery (inches)	VOC (PPM)
	-, -, -, -	10	0.0, 0.0, 0.0, 0.2
	6, 9, 8, 10	16	0.0, 0.2, 0.4, 0.2
	14, 21, 50\4	16	0.0, 0.3, 0.5, 0.2
	5, 6, 7, 9	12	0.0, 0.0, 0.0, 0.0
	5, 6, 7, 9	12	0.0, 0.0, 0.0, 0.0
	10, 11, 50, 31	12	0.0, 0.0, 0.0, 0.0
	12, 15, 8, 11	14	0.0, 0., 0.0, 0.0
	7, 5, 18, 21	10.5	0.0, 0.0, 0.0, 0.0
	7, 15, 19, 21	14	0.0, 0.0, 0.0, 0.0

SUBSURFACE PROFILE

Depth (ft)	Description	Formation	Remarks
0–4	Lt. Orange and Red to Red Brown mf SAND, trace Silt, trace Clay, little to some cf Brick pieces, debris, some f Gravel.	Fill	Dry to moist, no odor, no stains.
4–8	Dark Gray mf SAND, little Silt, little cf Gravel, little Brick.	Fill	Moist, no odor, no stains.
8–10	Dark Gray mf SAND, little Silt, some Red Brick, little cf Gravel.	Fill	Dry, no odor, no stains.
10–12	Greenish Gray mf SAND, little Gray Silt, trace cf Gravel, little Red Brick.	Fill	Moist, no odor, no stains.
12–14	Dark Gray cf SAND, little Gray Silt, cf Gravel.	Fill	Wet, no odor, no stains.
14–18	Dark Gray cm SAND, little Gray Silt, cf Gravel.	Fill	Moist, no odor, no stains.
18	End of Boring		

Depth (ft/m): 1, 2, 3 – 1, 4, 5, 6, 7 – 2, 8, 9, 10 – 3, 11, 12, 13 – 4, 14, 15, 16 – 5, 17, 18, 19, 20 – 6

Well Completion Details



Elevation (Ft. MSL): -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, -14, -15, -16, -17, -18, -19, -20

Drilling Company: Tabasco Drilling
Driller: William Lightner/William Anderson
Drilling Method: Hollow Stem Auger
Auger Size: 6 1/4" ID
Hole Diameter: 10"

DRESDNER ROBIN
371 Warren Street
P.O. Box 38
Jersey City, NJ 07302

Casing Diameter: 4"
Date Start: 10/07/08
Date Finish: 10/7/08
Checked By: RG
Sheet 1 of 1

Remington and Vernick Engineers
Test Boring Logs, 07/16/01

Remington & Vernick Engineers

232 King's Highway East Haddonfield, New Jersey 08033

TEST BORING LOG

Sheet 1 of 1

Project No. 0408V123 | **Date:** July 16, 2001
Project: AABCO Steel Drum | **Client:** City of Camden
Location: 308 - 322 North Front Street, Camden, New Jersey | **Log of Boring No.** B - 1

BORING DEPTH (FEET)	BLOW COUNT	SAMPLE DEPTH (FEET)	CLASSIFICATION OF MATERIALS (based on samples recovered plus observation of material returned between samples)
0	11-13-10	0 - 1	Reddish yellow coarse to medium to fine sand, trace silt, trace gravel
		1 - 2	Brownish yellow fine sand, trace silt
	7-6-7-5	2 - 4	same
	8-13-16-37	4 - 6	Yellowish brown coarse to fine sand, trace fill, trace silt
5			
	47-100/5.5	6 - 8	same
	17-39-41-33	8 - 9	Light brownish gray medium to fine sand; little fill; little silt with reddish yellow and yellowish brown mottles
		9-10	Light brownish gray coarse to medium to fine sand, trace silt, trace gravel, with redish yellow mottles, little fill
10	41-43-45-52	10-11	Yellowish brown coarse to medium to fine sand, littlefill, trace silt, trace gravel
		11-12	Strong brown coarse medium to fine sand;trace fill; trace silt
	16-25-24-24	12 - 14	Yellowish brown medium to coarse to fine sand, little gravel, trace silt; (wet)
	7-12-18-20	14 - 16	Yellowish brown medium to coarse to fine sand, little silt, trace gravel
15			
	12-16-18-20	16 - 18	Reddish brown medium coarse sand; little silt and trace gravel

GROUNDWATER INFORMATION	
DATE:	7/16/01
TIME:	During Drilling
DEPTH:	11.5'

CONTRACTOR: Lipincott
DRILLER: Jim Maier
EQUIPMENT Diedrich D-10 Drill Rig
INSPECTOR: Mark Muraczewski

Remington & Vernick Engineers

232 King's Highway East Haddonfield, New Jersey 08033

TEST BORING LOG

Sheet 1 of 1.

Project No. 0408V123 .
Project: AABCO Steel Drum
Location: 308 - 322 North Front Street, Camden, New Jersey

Date: July 16, 2001 .
Client: City of Camden
Log of Boring No. B - 2 .

BORING DEPTH (FEET)	BLOW COUNT	SAMPLE DEPTH (FEET)	CLASSIFICATION OF MATERIALS (based on samples recovered plus observation of material returned between samples)
0	25/0	0 - 2	Concrete and wood
		2 - 4	same
	8-6-9-15	4 - 6	Yellowish brown medium to fine sand, trace fill, trace gravel, trace silt
5			
	22-36-38-51	6 - 8	Yellowish brown medium to fine sand, little fill, little gravel
	22-43-43-48	8 - 10	Yellowish brown coarse to medium to fine sand, little fill, little gravel
			same, with dark red mottles @ 9'
10	48-52-53-47	10 - 12	same as above (wet)
	16-26-36-41	12 - 14	Yellowish brown coarse to medium to fine sand, trace silt, little gravel
	13-15-13-26	14 - 16	Dark yellowish brown medium to fine sand, little silt, little gravel
15			
	17-36-42-40	16 - 18	same, with trace clay

GROUNDWATER INFORMATION	
DATE:	7/16/01
TIME:	During Drilling
DEPTH:	12'

CONTRACTOR: Lipincott
DRILLER: Jim Maier
EQUIPMENT Diedrich D-10 Drill Rig
INSPECTOR: Mark Muraczewski

Remington & Vernick Engineers

232 King's Highway East Haddonfield, New Jersey 08033

TEST BORING LOG

Sheet 1 of 1.

Project No. 0408V123 .
Project: AABCO Steel Drum
Location: 308 - 322 North Front Street, Camden, New Jersey

Date: July 16, 2001 .
Client: City of Camden
Log of Boring No. B - 3 .

BORING DEPTH (FEET)	BLOW COUNT	SAMPLE DEPTH (FEET)	CLASSIFICATION OF MATERIALS (based on samples recovered plus observation of material returned between samples)
0	2-4-6-3	0 - 2	Reddish yellow medium to fine sand with crushed brick fill, trace gravel
	3-3-2-3	2 - 3	refusal (crushed red brick)
		3 - 4	Crushed red brick
	4-4-16-26	4 - 6	Strong brown medium to fine sand, little fill, trace silt, little gravel
5			
	23-27-38-53	6 - 8	Yellowish brown coarse to medium to fine sand, little fill, trace silt;trace gravel
	23-46-95-92	8 - 10	Strong brown/yellowish medium to fine sand, little fill, little gravel, trace silt, with red
			mottles
10	50-65-60-50	10 - 12	same as above
	16-18-16-30	12 - 14	Dark yellowish brown fine sand, little silt, trace gravel, trace fil
	12-38-40-12	14 - 16	Orange brown coarse to medium to fine sand, little silt, trace gavel, trace reddish
			brown clay
15			
	12-15-20-13	16 - 17.5	same as above
		17.5 - 18	Light olive/gray/red fine sand, trace silt

GROUNDWATER INFORMATION	
DATE:	7/16/01
TIME:	During Drilling
DEPTH:	11'

CONTRACTOR: Lipincott
DRILLER: Jim Maier
EQUIPMENT Diedrich D-10 Drill Rig
INSPECTOR: Mark Muraczewski

Remington & Vernick Engineers

232 King's Highway East Haddonfield, New Jersey 08033

TEST BORING LOG

Sheet 1 of 1.

Project No. 0408V123.
Project: AABCO Steel Drum
Location: 308 - 322 North Front Street, Camden, New Jersey

Date: July 16, 2001.
Client: City of Camden
Log of Boring No. B - 4.

BORING DEPTH (FEET)	BLOW COUNT	SAMPLE DEPTH (FEET)	CLASSIFICATION OF MATERIALS (based on samples recovered plus observation of material returned between samples)
0	6-6-5-8	0 - 2	Crushed brick and concrete over yellowish brown medium to fine sand
	33	2 - 4	refusal
	2-18-22-38	4 - 6	Dark yellowish brown medium to fine sand, trace gravel, little fill, trace silt,
			concrete
5			
	22-39-45-50	6 - 8	Yellowish brown fine sand, fill material
	18-25-29-48	8 - 9	fill
		9 - 10	Strong brown coarse to medium to fine sand, little silt, trace gravel
10	29-29-19-21	10 - 11.	Strong brown coarse to medium to fine sand, with grayish brown clay pockets
		11 - 12	Brown medium to fine sand, little silt, trace gravel
	11-19-13-26	12 - 13	Strong brown coarse to medium to fine sand, trace silt, trace gravel
		13 - 14	Strong brown fine sand, trace gravel, little silt
	9-18-19-24	14 - 16	same as above
15			
	16-21-31-34	16 - 17	same as above
		17 - 18	Strong brown fine sand, little silt

GROUNDWATER INFORMATION	
DATE:	7/16/01
TIME:	During Drilling
DEPTH:	10.5'

CONTRACTOR: Lipincott
DRILLER: Jim Maier
EQUIPMENT Diedrich D-10 Drill Rig
INSPECTOR: Mark Muraczewski

Remington & Vernick Engineers

232 King's Highway East Haddonfield, New Jersey 08033

TEST BORING LOG

Sheet 1 of 1.

Project No. 0408V123 .
Project: AABCO Steel Drum
Location: 308 - 322 North Front Street, Camden, New Jersey

Date: June 19, 2001 .
Client: City of Camden
Log of Boring No. GR .

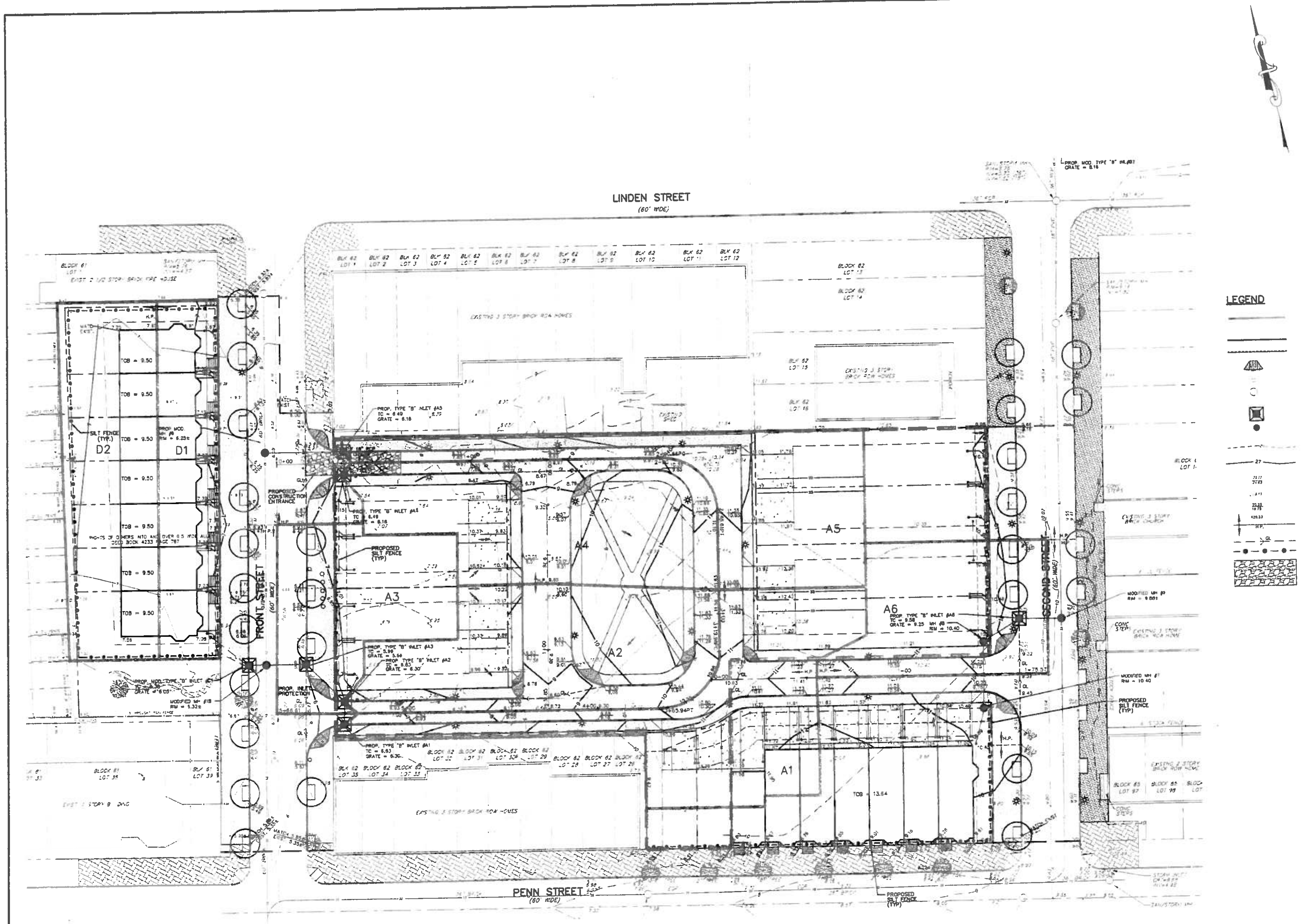
BORING DEPTH (FEET)	SAMPLE NUMBER	SAMPLE DEPTH (FEET)	CLASSIFICATION OF MATERIALS (based on samples recovered plus observation of material returned between samples)
0 - 3			Drilled Down through surface rubble of concrete, rebar, brick
			PID = 5.0
3 - 6	GR-6	6'	Brownish yellow medium to fine sand, trace gravel, trace silt;PID = 5.0
6 - 8	GR - 8	8'	Brown/olive green fine to medium sand, trace gravel, trace silt; PID = 2.0
8 - 10	GR - 10	10'	Brown/black/dark red medium to fine sand, trace silt; PID = 1.0
10 - 12	GR - 12	12'	Brown/dark gray medium to fine sand, trace silt; PID = 1.0
12 - 14	GR - 14	14'	Brown/dark gray medium to fine sand, trace silt; PID = 1.0
14 - 15	GR - 15	15'	Brown coarse to fine sand; PID = 1.0
			EOB @ 15'
			**Odor Detected
			**PID = 1 - 5

GROUNDWATER INFORMATION	
DATE:	6/19/01
TIME:	During Drilling
DEPTH:	11'

CONTRACTOR: Lipincott
DRILLER: Jim Maier
EQUIPMENT Drill Rig
INSPECTOR: Mark Muraczewski

APPENDIX C

Soil Erosion and Sediment Control Plan (CES, Feb. 2006)



Henry J. Haley 12/15/06
DATE

HENRY J. HALEY
PROFESSIONAL ENGINEER, NEW JERSEY LIC. NO. 24098

RRD	12/15/06	REVISED DWELLINGS FROM PHASE II	
JDO	8/30/05	REV PER COORDINATION MEETING	
TJ	6/23/04	REV PER REVIEW ENGINEERS LETTERS	
MPC	06/23/04	REVISED PER ENGINEERS MEETING	
TJ	5/18/04	REVISED PER REVIEW LETTER	
TJ	03/18/04	REVISED PER REVIEW LETTER DATED 11/14/03	
DRWN	DATE	REVISIONS	CHK'D

SOIL EROSION & SEDIMENT CONTROL PLAN

COOPER GRANT HOMES by PENNROSE PROPERTIES

PLATE 11, BLOCK 57, LOTS 48, 49–51, 54–58 & 61–63; PLATE 12,
BLOCK 61, LOTS 17 AND 27–30; BLOCK 62, LOTS: 21,22,23,38 & 45
CITY OF CAMDEN, CAMDEN COUNTY, NEW JERSEY

PREPARED BY
CONSULTING ENGINEER SERVICES
PROFESSIONAL ENGINEERS, PLANNERS, & LAND SURVEYORS
150 DELSEA DRIVE, SUITE 1, SEWELL, NEW JERSEY 08080
PHONE (856) 228-2200 - FAX (856) 232-2346
N.J. CERTIFICATE OF AUTHORIZATION No. GA278725

SHT. No. 12 OF 13 DATE: 10/10/03 SCALE: 1"=20' CES No. 2006-02 FILE No. ____ DRAWN BY: TJ

SOIL EROSION AND SEDIMENT CONTROL NOTES

1. All soil erosion and sediment control practices to be installed prior to any major soil disturbances, or in their proper sequence, and maintained until permanent protection is established.

2. Any disturbed areas that will be left exposed more than 30 days and not subject to construction traffic, will immediately receive a temporary seeding. If the season prevents the establishment of a temporary cover, the disturbed areas will be mulched with straw, or equivalent material, at a rate of two (2) tons per acre, according to State Standards.

3. Permanent vegetation to be seeded or sodded on all exposed areas within ten (10) days after final grading. Mulch will be used for protection until seeding is established.

4. All work to be done in accordance with the State Standards for Soil Erosion and Sediment Control in New Jersey.

5. A sub-base course will be applied immediately following rough grading and installation of improvements in order to stabilize streets, roads driveways and parking areas. In areas where no utilities are present, the sub-base shall be installed within fifteen (15) days of preliminary grading.

6. Immediately following initial disturbance or rough grading, all critical areas subject to erosion (i.e.: steep slopes, roadway embankments) will receive a temporary seeding in combination with straw mulch or a suitable equivalent, at a rate of two (2) tons per acre, according to State Standards.*

7. Any steep slopes receiving pipeline installation will be backfilled and stabilized daily, as the installation proceeds (i.e.: slopes greater than 3:1).*

8. Traffic control standards require the installation of 50' x 30' x 1' pad of 1 1/2 to 2 inch stone, at all construction driveways immediately after initial site disturbance.*

9. In accordance with the Standards for Permanent Vegetative Cover for Soil Stabilization, any soil having a pH of 4 or less or containing iron sulfides shall be covered with a minimum of 12 inches or soil having pH of 5 or more, prior to seedbed preparation.

10. The Camden County Soil Conservation District shall be notified 72 hours in advance of any land disturbing activity.

11. At the time when the site preparation for Permanent Vegetative Stabilization is going to be accomplished, any soil that will not provide a suitable environment to support adequate vegetative ground cover, shall be removed or treated in such a way that will permanently adjust the soil conditions and render it suitable for vegetative ground cover. If the removal or treatment of the soil will not provide suitable conditions, non-vegetative means of permanent ground stabilization will have to be employed.

12. In that N.J.S.A. 4:24-39 et seq. requires that no Certification of Occupancy shall be issued before the provisions of the certified plan for soil erosion and sediment control have been complied with for permanent measures, all site work for site plans and all work around individual lots in subdivision, will have to be completed prior to the District issuing a Report of Compliance for the issuance of a Certificate of Occupancy by the municipality.

13. Conduit Outlet Protection must be installed at all required outfalls prior to the drainage system becoming operational.*

14. Any changes to the site plan will require the submission of a revised Soil Erosion and Sediment Control Plan to the Camden County Soil Conservation District for re-certification. The revised plans must meet all current New Jersey Soil Erosion and Sediment Control Standards.

15. The Camden County Soil Conservation District shall be notified or any changes in ownership.

* Where Applicable

GENERAL MAINTENANCE

1. Maintenance shall occur on a regular basis consistent with favorable plant growth soil and climate conditions.
2. All proposed sediment basins shall be removed of silt and sediment so that proper contact time is achieved to obtain proper sediment requirements.
3. All rip rap and construction entrance shall be raked as required to maintain intended use.
4. When it becomes necessary, the owner shall inform the contractors of unsatisfactory condition or erosion and sediment devices. At such time the contractor shall improve the conditions of said devices to meet with the approval of the owner.
5. Should unforeseen erosion conditions develop during construction, the contractor shall take action to remedy such conditions and to prevent damage to adjacent properties as a result of increased runoff and/or sediment displacement.
6. Seeded areas that have been washed away shall be filled and graded as necessary and then reseeded. The procedure shall be repeated after each storm or until no more signs of erosion are evident.
7. Control measures shall apply to subsequent owners if title is conveyed.
8. The owner shall be responsible for maintenance of soil erosion and sediment control measures during and after construction.

SCHEDULE OF SEED MIXES FOR SOIL STABILIZATION

TEMPORARY SEED MIX	RATE (LBS/ACRE)	PERMANENT SEED MIX	RATE (LBS/ACRE)
WINTER RYE	55	PERENNIAL RYE	55
WEEPING LOVEGRASS	10	CHEWINGS RED FESCUE	40
ANNUAL RYE	55	CREEPING RED FESCUE	40
SERICEA LESPEDEZA	55	KENTUCKY BLUE GRASS	40
	175 LBS. MIN.		175 LBS. MIN.

1. ALL SEEDING, STABILIZATION, ETC. TO BE AS SPECIFIED IN "STANDARDS FOR SOIL EROSION/SEDIMENT CONTROL IN NEW JERSEY."

2. FERTILIZER TO BE 10-6-4 OR 10-5-5 APPLIED AT 800 TO 1000 LBS/ACRE, OR 5-10-10 OR 5-10-5 APPLIED AT 500-600 LBS/ACRE. EXACT APPLICATION RATE TO BE DETERMINED BY SOIL TESTING.

3. GROUND LIMESTONE TO BE SPREAD AT VARYING RATES TO CORRECT EXISTING pH VALUES TO A LEVEL OF 6.5.

TEMPORARY SOIL STABILIZATION COVER

Prior to halting construction for periods longer than 30 days and during the offseason, the contractor shall stabilize with temporary vegetative cover and all exposed soils. Temporary vegetative cover shall be accomplished by the following methods and materials.

1. Fertilizer shall be applied at a rate of 500 lbs/acres or 11 lbs/1000 S.F. of 10-20-10 or equivalent. If seed is drilled over banded fertilized, the rate of fertilizer may be reduced by 50%.

2. Limestone shall be applied at a rate of 2 tons/acre or 90 lbs/1000 S.F. Limestone equivalent to 50% calcium plus magnesium oxides shall be used.

3. Lime and fertilizer shall be worked into the soil as nearly as practical to a depth of 4 inches with a disc, springtooth harrow, or other suitable equipment.

4. Mulching shall be applied after seeding. Mulch materials shall be unrotted, small grain straw, hay free of sees, or salt hay to be applied at the rate of 1 1/2 to 2 tons per acre (70 to 90 lbs/1000 S.F.), except that where crimper is used instead of a liquid mulch-binder (tackifying or adhesive agent), the rate of application shall be doubled. Mulch shall be spread uniformly so that approximately 75% to 95% of the soil surface will be covered.

5. Mulch shall be anchored immediately after placement by:

   LIQUID MULCH BINDERS - May be used to anchor salt hay or straw mulches.

   a. Applications should be heavier at edges where wind catches the mulch, in valleys and at crests of banks. Remainder of area should be uniform in appearances.

   b. USE ONE OF THE FOLLOWING:

      1. Emulsified Asphalt: (SS-1, CSS-1, CMS-2, MS-2, RS-1, RS-2 CRS-1 and CRS-2). Apply 0.04 gal/sq.yd. or 194 gal/acre on flat slopes less than 8 feet high. On slopes, 8 feet or more high, use 0.75 gal/sq.yd. per 363 gal/acre.

      2. Cutback Asphalt: Rapid Curing (RC-70, RC-250 and RC-800) or Medium Curing (MC-250 or MC-800) Apply 0.04 gal/sq.yd. or 194 gal/acre on flat areas and on slopes less than 8 feet high. On slopes, 8 feet or more high, use 0.075 gal/sq.yd. 363 gal/acre.

      3. Synthetic or organic binders, binders such as Curasol, DCA-70, Perto-Set and Terra-Tact may be used at rates recommended by the manufacturer to anchor mulch materials.

   Note: All names given above are registered trade names. This does not constitute a recommendation of these products to the exclusion of other products.

   c. Wood-fiber or paper-fiber mulch at the rate of 1,500 pounds per acre may be applied by a hydroseeder. Use is limited to flatter slopes and during optimum seeding periods in spring and fall.

6. Mulch may be used in place of temporary seeding if spread at a rate of 2.0 to 2.5 tons per acre and anchored as discussed above. A mulch anchoring tool may be used where conditions permit. Tool penetration shall be done about 3 to 4 inches. On sloping land, the operation shall done on the contour.

7. Temporary seed mix shall be annual ryegrass with a rate of 40 lbs/acre or 1 lb/1000 S.F. seed mix shall be applied uniformly. Mulch shall not be included in the tank with the seed. Except for drilled, hydroseeded or cult packed seedings, seed shall be incorporated into the soil to a depth of 1/4 to 1/2 inch by raking or dragging.

8. Seeding mix shall be applied between 3/1 - 5/15 or 8/15 - 10/1 when required. If stabilization is required outside these seeding dates, mulch shall be used as defined item no. 6.

PERMANENT VEGETATIVE COVER: Immediately following the completion of construction activities at the site, the contractor shall stabilize with permanent vegetative cover, all exposed and disturbed soils. Permanent vegetative cover shall be accomplished as specified below:

1. Topsoiling: The contractor shall prepare ares to be stabilized with permanent vegetative cover by applying topsoil to a uniform depth of 4 inches. Topsoil shall be friable and loamy and of good quality.

2. Fertilizer: Shall be applied at a rate of 500 lb/acre of 11 lbs/1000 S.F. of 10-20-20 or equivalent. In addition, 300 lbs or 38-0-0 per acre or equivalent of slow release nitrogen may be used in lieu of topdressing.

3. Limestone: Shall be applied at a rate of 3 tons/acre 135 lbs/1000 S.F. Limestone equivalent of 50% calcium plus magnesium oxides shall be used.

4. Lime and Fertilizer: Shall be worked into the soil as nearly as practical to a depth of 4 inches until a reasonable uniform, fine seedbed prepared.

5. Mulching: Shall be applied after seeding. Mulch materials shall be unrotted, small grain straw, half free of seeds, or salt hay to be applied at a rate of 1 1/2 to 2 tons per acre (70 lbs to 90 lbs/1000 S.F.), except that where a crimper is used instead of a liquid mulch-binder (tackifying or adhesive agent), the rate of application shall be 3 tons/acre.

6. Mulching shall be anchored immediately after placement by the following method: Liquid Mulch Binders

7. Topdressing: An application of fertilizer such as 10-10-10 or equivalent at 400 lbs/acre or 10 lbs/1000 S.F. between September and October 15 shall be required for spring seeding unless a slow release nitrogen is used as stated above.

STANDARDS FOR DUST CONTROL

During construction activity the following methods should be considered:

a) Calcium Chloride - Shall be in a loose, dry granular form fine enough to use in a standard seed spreader, at a rate that will keep the subject surface moist, but not cause plant damage or pollution by saturation if used on steep slopes other measures shall be taken to insure protection from contamination into streams, storm sewers or accumulating around plant life.

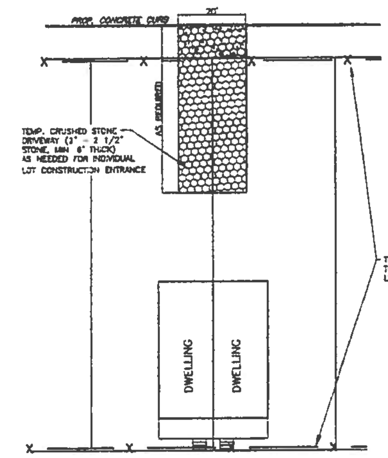
b) Sprinkling - shall be of non-contaminated water sprinkled at a rate to wet the subject surface but not to cause erosion or ponding - impoundment.

Other methods acceptable are listed in "the Standards For Soil Erosion And Sediment Control for the State of New Jersey" Issue April 1987 Section 4.10.1.

CONSTRUCTION SEQUENCE

1. MOBILIZATION 1 DAY
2. CONSTRUCT TEMPORARY SOIL EROSION AND SEDIMENT CONTROL FACILITIES. 2 DAYS
3. BEGIN DEMOLITION OF EXISTING FACILITIES 1 WEEK
4. CLEARING AND ROUGH GRADING 1 WEEK
5. CONSTRUCT AND MAINTAIN TEMPORARY COVER TO STABILIZE DISTURBED AREAS. 2 DAYS
6. CONSTRUCT CURBING AND SIDEWALK. 2 WEEKS
7. CONSTRUCT BUILDING & DRIVEWAYS 12± MONTHS
8. COLLECT SILT AND SEDIMENT AND PLACE ON SITE. 1 DAY
9. ESTABLISH PERMANENT COVER AND LANDSCAPING. 2 WKS

ESTIMATED TOTAL TIME OF CONSTRUCTION 1± YEAR

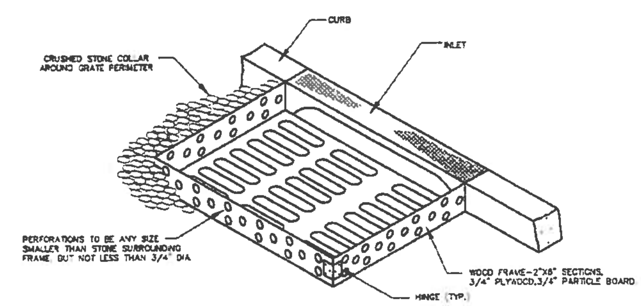


NOTES

1. RESPONSIBILITY FOR PLACEMENT AND MAINTENANCE OF SOIL EROSION CONTROL MEASURES ON ANY GIVEN LOT BELONGS TO THE PERSON(S) DOING THE DISTURBANCE OR CONSTRUCTION.
2. LOT MUST BE STABILIZED (SEEDED AND MULCHED) PRIOR TO REQUESTING A CERTIFICATE OF COMPLIANCE.

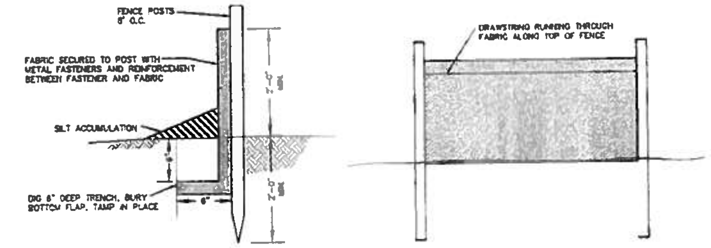
TYPICAL LOT DETAIL

SCALE: 1" =20'



INLET SEDIMENT PROTECTION STRUCTURE

NTS

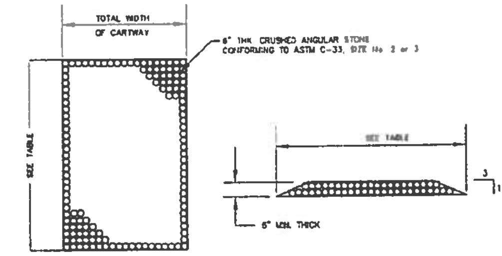


NOTES

1. FENCE POSTS SHALL BE HARDWOOD WITH A MINIMUM THICKNESS OF 1-1/2 INCHES.
2. WHERE INDICATED ON THE PLANS, SILT FENCE MAY BE REINFORCED WITH METAL WIRE FENCE. REINFORCEMENT FENCE SHALL BE AT LEAST 2 FEET HIGH AND SHALL HAVE OPENINGS NO GREATER THAN 6 INCHES WIDE.

SILT FENCE DETAIL

N.T.S.



PERCENT SLOPE OF ROADWAY	LENGTH OF STONE REQUIRED	
	COARSE GRAINED SOILS	FINE GRAINED SOILS
0 to 2%	50 FEET	100 FEET
2 to 5%	100 FEET	200 FEET
>5%	ENTIRE SURFACE STABILIZED WITH FABC BASE COURSE	

MAINTENANCE

THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAYS. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE OR ADDITIONAL LENGTH AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED, OR TRACKED ONTO PUBLIC RIGHT-OF-WAYS MUST BE REMOVED IMMEDIATELY.

STABILIZED CONSTRUCTION ENTRANCE DETAIL

N.T.S.

PREPARED BY
CONSULTING ENGINEER SERVICES
PROFESSIONAL ENGINEERS, PLANNERS, & LAND SURVEYORS
150 DELSEA DRIVE, SUITE 1, SEWELL, NEW JERSEY 08080
PHONE (856) 228-2200 - FAX (856) 232-2346
N.J. CERTIFICATE OF AUTHORIZATION No. GA27873

SOIL EROSION & SEDIMENT CONTROL NOTES AND DETAILS
COOPER GRANT HOMES by PENNROSE PROPERTIES
PLATE 11, BLOCK 57, LOTS 48, 49-51, 54-58 & 61-63; PLATE 12, BLOCK 61, LOTS 17 AND 27-30; BLOCK 62, LOTS:21,22,23,38 & 45
CITY OF CAMDEN, CAMDEN COUNTY, NEW JERSEY

EPG	08/23/04	REVISED FOR ENGINEERS MEETING	
DRWN	DATE	REVISIONS	CHK'D

SHT. No. 15 OF 15 DATE: 10/10/03 SCALE: 1"=30' CES No. 2005-02 FILE No. DRAWN BY: JL

Henry J. Haley 6/23/04
HENRY J. HALEY DATE
PROFESSIONAL ENGINEER, NEW JERSEY LIC. NO. 24098

APPENDIX D

Site-Specific Brownfields Sampling, Analysis, and Monitoring Plan (SAMP)

Site-Specific Brownfields Sampling, Analysis, and Monitoring Plan

Camden Redevelopment Agency
ABC Barrel Co. Project,
308-322 No. Front Street Site, Camden, NJ

The attached U.S. EPA Region 2 Sampling, Analysis, and Monitoring Plan (SAMP) template has been submitted in compliance with the provisions of Brownfields Hazardous Substances Cleanup Grant Cooperative Agreement No. BF 97216411, New Jersey.

The undersigned agrees to follow the accompanying Generic Brownfields QAPP boilerplate to prepare site-specific SAMPs using this template for remedial pilot projects funded under the U.S. EPA Region 2 Brownfields Economic Re-development Initiative. The undersigned also agrees to incorporate any comments provided by their governing state environmental regulatory authorities (NJDEP) concerning the development of site-specific SAMPs.

Municipal Brownfields Pilot Project Manager Concurrence:
Signature

Printed Name/Date

U.S. EPA Region 2 Project Manager Approval:
Signature

Printed Name/Date

and when applicable

State/Commonwealth Project Manager Approval:
Signature

Printed Name/Date

U.S. EPA Region 2
Site-Specific Brownfields Sampling, Analysis, and Monitoring Plan (SAMP)
ABC Barrel Company Site, City of Camden, New Jersey

CONTENTS

CAMDEN COUNTY
ABC Barrel Company Site
Brownfield SAMP

Project Organization Chart

DRESDNER ROBIN
Engineering, Environmental, Planning, Surveying & Landscape Architecture

NJDEP
Bureau of Southern Brownfield Operations
Project Manager
Cheryl Priest

Camden Redevelopment Agency
Brownfields Grant Administrator
James Harveson

U.S.EPA Region 2
Project Manager
Alison Devine

Dresdner Robin
Project Coordinator
Geoffrey Forrest, PG, CP Eng, LSRP

Dresdner Robin
Project Manager/Task Leader
Raymond Glover, PG, CPG

Dresdner Robin
Corporate
Health & Safety
Richard Mailhot

Dresdner Robin
Environment Permitting / Community Outreach

Permitting
Raymond Glover, PG, CPG
Geoffrey Forrest, PG, CP Eng, LSRP

Community Outreach
James Harveson
Geoff Forrest, PG, CP Eng, LSRP

Dresdner Robin
Remedial Investigation/Sampling

Quality Assurance Officer and Field Sampling Supervisor
Garry Gutshteyn

Field Sampling
Gina Quinones
Nicholas Kasimis

Dresdner Robin

Data Validation
John Tregidgo

Data QA/QC
Gina Quinones
Elena DeFeo

Reporting
Geoff Forrest, PG, CP Eng, LSRP
Raymond Glover, PG, CPG
Elena DeFeo

CAD
Garry Gutshteyn
Nicholas Kasimis

Contractor
Community Outreach
TBD

Contractor
Permitting
TBD

Contractor
Analytical Lab
TBD
Surveying
TBD

Contractor
Excavation/Drilling
TBD
Soil/Water Sampling
TBD

Contractor
Data Validation
QA/QC/Reporting
TBD

Contractor
Waste Transportation and Disposal Facility
TBD

B.0 Project Organization and Responsibilities

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, information on essential personnel and/or organizations that are necessary to perform the remedial activities for the SAMP and their responsibilities within the project organization are presented in this section. To assure that these activities will proceed in a correct and cost effective manner, key individuals are identified who will be responsible for the following tasks:

- Overall project coordination.
- Overall QA.
- Systems auditing (on-site evaluations).
- Performance auditing.
- Sampling operations.
- Sampling QC.
- Laboratory analyses.
- Laboratory QC.
- Data processing activities.
- Data processing QC.
- Data quality review.

To assist in the overall organization of the project and for successful completion of the individual tasks for the ABC Barrel Company Brownfields SAMP, an organizational chart is presented that illustrates the principal infrastructure of a project. As shown in the organizational chart in Section B.1, due to the size and scope of the project, certain key individuals will be responsible for more than one project function.

B.1 Organizational Chart

This section of the ABC Barrel Company Site Brownfields SAMP presents and an organizational chart that identifies the chain of command for key personnel, including the QA representative, participating in the proposed site investigation project. Included in the organizational chart are titles, responsibilities, and organization affiliation of all project participants. The Organizational Chart is attached.

B.2 Personnel Information

- Cheryl Priest
  Brownfields Project Manager
  NJDEP Bureau of Southern Field Operations
  401 East State Street
  Trenton, NJ 08608
  (609) 584-4150

  Ms. Priest will represent NJDEP Bureau of Southern Field Operations in its review and oversight function, in its financial sponsorship, and as ultimate arbiter on technical matters.

- James Harveson
  Brownfields Grant Administrator
  Camden Redevelopment Agency
  520 Market St # 1300
  Camden, NJ 08102-1300
  (856) 757-7600

  Mr. Harveson will represent Camden Redevelopment Agency in the review and oversight of the project; will interact with the media and citizens, and will provide a point of contact for acquiring Camden Redevelopment Agency services and permissions at owned sites.

- Geoffrey Forrest, PG, CP Eng, LSRP
  Project Coordinator
  Dresdner Robin
  371 Warren Street, 3rd Floor
  P.O. Box 38
  Jersey City, NJ 07303-0038
  (201) 681 - 9832

  Mr. Forrest will oversee the project, provide quality control on documents and determinations; and will mentor the daily manager of the project, Mr. Raymond Glover.

- Raymond Glover, PG, CPG
  Project Manager
  Dresdner Robin
  371 Warren Street, 3rd Floor
  P.O. Box 38
  Jersey City, NJ 07303-0038
  (201) 926 - 7693

  Mr. Glover will manage the project on a daily basis including oversight of bid specifications preparation, management and oversight of field sampling efforts and the contractors contaminated soil excavation and disposal operations. In addition, Mr. Glover will be responsible for preparation of the Remedial Action Report.

- Garry Gutshteyn
  Quality Assurance Officer and Field Sampling Supervisor
  Dresdner Robin
  371 Warren Street, 3rd Floor
  P.O. Box 38
  Jersey City, NJ 07303-0038
  (201) 759 - 5553

  Mr. Gutshteyn will ensure contractor and subcontractor compliance with the Quality Assurance Project Plan (QAPP), SAMP, and Health and Safety Plan. Additionally, Mr. Gutshteyn will monitor the contractors performance during the contaminated soil excavation and disposal activities, including inspections of the contractors transportation and disposal documentations.

- John Tregidgo
  Data Validation
  Dresdner Robin
  371 Warren Street, 3rd Floor
  P.O. Box 38
  Jersey City, NJ 07303-0038
  (201) 320 - 7083

  Mr. Tregidgo will conduct reviews of the analytical data for quality assurance and quality control purposes, and assure that the data quality objectives are achieved. Additionally, Mr. Tregidgo will perform qualitative data validation of the analytical laboratory results in accordance with EPA guidelines.

- Gina Quinones
  Staff Geologist
  Dresdner Robin
  371 Warren Street, 3rd Floor
  P.O. Box 38
  Jersey City, NJ 07303-0038
  (201) 232 - 3414

  Ms. Quinones will oversee the contractor's soil delineation and waste classification sampling programs. In addition, Ms. Quinones will assist the Project Manager during all field activities.

- Elena DeFeo
  Staff Hydrogeologist
  Dresdner Robin
  371 Warren Street, 3rd Floor
  P.O. Box 38
  Jersey City, NJ 07303-0038
  (201) 988 – 9390

  Mrs. DeFeo will conduct data compilation and analysis of field and analytical data and will assist the Project Manager with Remedial Action Report preparation.

B.3 Laboratory Information

Laboratory Name & Address[1]	Contact & Telephone Number	Sample Analyses
Laboratory will be selected by the Contractor and/or his representative following award of the contract. Information will be provided to NJDEP/USEPA upon receipt.		

[1] Demonstration of a laboratory's capability, with respect to their ability to analyze selected contaminants, should be ascertained whenever possible. One approach to rendering such a determination is to obtain Performance Evaluation (PE) results for any pertinent analyses from an ongoing state or federal monitoring program. If no applicable PE results are available, method control samples containing the analytes of interest at the concentration levels of concern could be submitted prior to initiating the project for pre-qualification. Alternately, an on-site audit or a quality assurance management plan review may be sufficient mechanisms means to assess a laboratory's ability.

C.0 Site Background

From 1996 through 2006, remedial activities have been conducted at the site that include a preliminary assessment, a site investigation, a remedial investigation, a supplemental remedial investigation for groundwater, and various remedial actions. The remedial activities completed were associated with seventeen (17) AOCs identified at the Site, three (3) of which require further remedial actions to comply with NJDEP's Site Remediation Program. The remaining AOCs requiring further remedial actions include a former trench area, a UST area, and historic fill materials which will be addressed as part of the final remediation phase at the Site. This section of the SAMP summarizes the results of the historic data review, site/remedial investigation and remedial actions that have been completed for the Site.

As presented in the historical data review, the site background information presented was based primarily upon the following documentation:1) *Preliminary Assessment Report*, AABCO Steel Drum Incorporated, Block 62 Lots 38 and 45; Block 65 Lot 103, Camden City, Camden County, NJ, Remington & Vernick Engineers, December 1996; 2) *Site Investigation Report*, AABCO Steel Drum Incorporated, Block 62 Lots 38 and 42; Block 65 Lot 103, Remington & Vernick Engineers, April 1999; 3) *Remedial Investigation Report* – AABCO Steel Drum, Inc., 308 to 322 North Front Street and 320 North 2nd Street, Block 62 Lots 38 & 45; Block 65 Lot 103; Remington & Vernick Engineers, October 2002; 4) *Site Investigation Report (8,000-Gal. Diesel UST and Piping)*, 308-322 N. Front Street, ENVision, Inc., February 2006; and 5) *Supplemental Remedial Investigation/Historic Remedial Action Report*, ABC Barrel Co. Site, 308-322 No. Front St., Camden City, Camden County, NJ, Dresdner Robin, July 2010.

The PA, SI and RI activities were conducted in accordance with the New Jersey Department of Environmental Protection (NJDEP) *Technical Requirements for Site Remediation* as contained in N.J.A.C. 7:26E. Quality Assurance for Sampling and Laboratory Analysis procedures utilized during these investigations were reported to be in conformance with the requirements of N.J.A.C. 7:26E-2.

C.1 Historical Data Review Report

Preliminary Assessment/Site History (1996)
A title/deed search for the property (Block 62 Lots 38 & 45) conducted as part of the PA indicated that the parcel was owned by Standard Tank & Seat Co. from 1936 to 1975; by Martin Aaron and Morris Silverman from 1975 to 1983; and by North Front Associates from 1983 to the time the PA was conducted. During this time, operators at the Site consisted of Standard Tank & Seat Company from 1906 to 1977; Martin Aaron/Pertnoy Drums, Inc. from 1977 to 1983; AABCO Steel Drum, Inc. from 1983 to 1987; and Container Recyclers from 1987 to the time of the PA.

The historical site usage was determined during the PA by a review of government files and Sanborn maps. Based upon information in the PA Report, from 1906 to 1977 it was reported that the property was used for manufacture of wooden toilet seats. From 1977 to 1981 site usage could not be determined however it was possible that drum refinishing processes were performed at the Site. From 1981 to 1987, the Site was used by Pertnoy Drums, Inc. and by AABCO Steel Drum, Inc as a drum finishing facility.

In 1987, it was reported that all drum washing/panting operations were ceased at the Site at which time the facility was used to store clean drums. In 1987, AABCO changed its name to Containers Recycling. In 1996 the property was foreclosed upon by the City of Camden.

The results of a historic aerial photograph review as reported in the PA over the period from 1940 through 1985 revealed that Block 62 Lots 38 and 45 always contained buildings in various configurations. It was reported that the structure occupying the central part of the Site appeared to have process pipes and vents along the roof.

Prior to November 1987, reported operations at the Site consisted of the reconditioning of steel drums by cleaning and painting open-ended drums, which was reportedly performed indoors. The various operations occurred within and adjacent to Buildings No. 1, No. 2, and No. 3 as identified on the Site Plan (**Figure 2 of RAW**). During the drum cleaning operations, the facility reportedly only accepted drums that could be cleaned using a caustic soda process. Hazardous wastes were generated at the facility included residual oil and rinse water from the drum washing process. Residual oil was initially collected in waste drums and later in a waste oil tank. It was reported that the waste oil was removed from the facility within 90 days by a licensed hazardous waste hauler. Wastes consisting of paint and solvent were also likely to have been generated during the drum painting process but documentation was not available to confirm this waste stream. The caustic soda rinse was reportedly pretreated than passed through an oil-water separator where sludge and oils were separated out. The remaining fluids were discharged to the sanitary sewer via a CCMUA discharge permit.

As reported in the PA, numerous site discharges and subsequent remedial activities occurred at the Site during 1984 through 1993 which were documented in NJDEP and Camden County files. These incidences included minor discharges of hazardous substances to soil; odor complaints; a surface discharge of No. 2 Fuel Oil from a UST regulator valve (NJDEP Case #84-10-13-00) from which 250 gallons were recovered and disposed off-site; several air permit violations issued by NJDEP Division of Waste Management; and various hazardous waste violations issued by NJDEP Division of Waste Management. A total of five (5) enforcement actions were taken by the NJDEP Department of Hazardous Waste Management and the Air & Environmental Quality Compliance and Enforcement Section concerning the above incidences. Administrative Orders were issued along with penalty assessments for violations relating to contingency planning and training for hazardous waste generators in 1986; solid waste management in 1987; operation of a paint booth without a permit in 1987.

The PA Report concluded that nineteen (19) areas of concern were present at the Site associated with the historic activities. The AOCs with confirmed or suspected contamination included: AOC-A2, AOC-B1 through B3, AOC-C1 through C5, AOC-CC, AOC-D1 through D3, AOC-E, AOC-E&J, AOC-G, AOC-I, AOC-O, AOC-P1, plus historic fill materials. The PA report proposed soil and groundwater sampling activities for these AOCs.

<u>Site Investigation (1999)</u>
In 1999, Remington & Vernick conducted a site investigation for the AABCO Steel Drum, Inc. Site in accordance with the requirements of N.J.A.C. 7:26E. The SI included soil and groundwater sampling for the AOCs as recommended in the PA Report. The site investigation consisted of field inspections and field screening, test pit excavations, soil borings, collection of soil samples, and groundwater sampling.

The results of the field investigation revealed that soil and groundwater contamination was present inside Buildings #1 and #2 that was associated with the drum washing operations and effluent that passed through an oil-water separator and piping that discharged to the sanitary/storm sewer system. Based upon the result of the analysis of seventy-five (75) samples that were collected during the SI, volatile and semi-volatile organic compounds, metals, phenols, PCBs, and petroleum hydrocarbons were detected at levels exceeding the most stringent NJDEP Soil Cleanup Criteria. Only two AOCs investigated on Block 62 Lots 38 & 42 were recommended for no further investigation: AOC-A2- the above ground water treatment tank outside Bldg. No. 1; and AOC-B2- the UST adjacent to northeast side of Bldg. No.2. Three monitoring wells (MW-1 through MW-3) were installed and sampled in the vicinity of the oil-water separator during the SI. The results of the sampling indicated that lead was detected in MW-1 near the oil-water separator exceeding the NJDEP Groundwater Quality Criteria. Therefore, further investigation of groundwater was recommended in the SI Report.

<u>Remedial Investigation (2001)</u>
During June through August 2001, Remington and Vernick conducted a remedial investigation of the ABC Barrel Co. Site for the OACs recommended in the SI Report. The RI activities were conducted in accordance with the NJDEP-approved "Remedial Investigation Work Plan", dated March 22, 2001. The AOCs investigated were AOC-B1, B3, C1 through C5, CC, D1 & D2, E & J, G, P1, and O, as shown on **Figure 2** and described in **Table 1 of the RAW**. In addition, four (4) soil borings were conducted near the corners of the property to characterize site-wide "historic fill materials" and a groundwater investigation was conducted to determine if impacts has occurred in the vicinity of AOCs-E&J and AOC-O. Based upon NJDEP's correspondence concerning the RI Report, dated August 24, 2006, additional groundwater investigation was required for AOC-B1 (8,000-Gal. UST and Piping), and a Remedial Action Report (RA) was required to document the remedial activities completed for AOC-B1, B2, B3, C1 through C6, D/K, E/M, and E/M, G, I, O, and P1 (see below for description).

<u>Historic Remedial Actions (2005-2006)</u>
In February 2005 EHS Environmental, Inc. (EHS) on behalf of Cooper Grant Developers, LLC, conducted removal actions for AOC-B1, AOC-B2, AOC-B3, AOCs-C1-C6, AOC-G, and AOC-O. The results of these remedial actions are summarized below.

<u>*AOC-B1 8,000-Gal.Diesel UST*</u>: 1ocated on the northeast side of Building No. 2, on February 2, 2005 the tank and associated contaminated soils were excavated and disposed off-site. The Site Investigation Report prepared by ENVision, Inc. dated February 10, 2006 indicated that post-excavation soil sample results for VOs and TPH were below the NJDEP Soil Cleanup Criteria. In a April 6, 2006 Correspondence, NJDEP did not require further remedial actions for AOC-B1.

<u>*AOC-B2 1,000-Gal.Fuel Oil UST and Piping:*</u> located adjacent to the east side of AOC-B1, soil analytical data collected during the RI indicated that TPHC was detected below the Soil Cleanup Criteria. Documentation was not available to indicate that post-excavation samples were collected from below the tank when it was removed or if the contents were removed/disposed. Therefore, NJDEP could not determine if addition remedial actions were required and requested documentation be provided to confirm the remedial actions for this AOC.

AOC-B3 1,000-Liquid Waste Oil UST: 1ocated adjacent to Building No. 1, the tank and associated contaminated soils were excavated and disposed off-site. Documentation provided by React Environmental Professional Services Group, Inc. (REPSG) indicated that post-excavation soil sample results for TPH, VOs, SVOs, and metals were below the NJ Soil Cleanup Criteria. NJDEP required that documentation be provided to confirm the remedial actions. Details of the remedial actions were provided to NJDEP in the July 2010 Remedial Investigation/Remedial Action Report prepared by Dresdner Robin, which was approved by NJDEP in a September 30, 2010 correspondance.

AOC-C1-C5, AOC-C6, AOC-G and AOC-O: The initial removal activities for these AOCs were completed by EHS in February 2005 in coordination with removal of the building foundations and slabs. Site documentation referenced removal of three AOCs: 1) AOC-C1-C5 - drum rinsing area inside Building No. 1; 2) AOC-C6 - concrete pit area located inside Building No. 2); and 3) AOC-G and AOC-O - floor drain/trench/piping and oil water separator located adjacent to Building No. 1. During the week of March 27, 2006, REPSG completed contaminated soil excavations for these AOCs. The location of the excavation areas were determined in the field by REPSG based upon the contaminated soils delineated during the RI. The excavations continued until no physical evidence of contamination was observed. The contaminated soils removed were disposed off-site. Post-excavation soil samples were collected from the bottom and sidewalls of the excavations to confirm the soil removals. of the contaminated soils. The analytical results indicated that tetrachloroethene (PCE) was present in sample 06-PE-005 at 520 mg/Kg exceeding the NJ Soil Cleanup Criteria (SCC). Lead was detected in five (5) samples and antimony in one (1) sample from AOC-G exceeding the SCC.

Supplemental Remedial Investigation Activities

To comply with NJDEP requirements, DRESDNER ROBIN conducted a groundwater investigation in the vicinity of AOC-B1, the former 8,000-Gal Diesel UST and Piping System (**Figure 3 of RAW**). The investigation included collection of a groundwater screening sample from a temporary well, followed by the installation of a permanent well (MW-1) and collection of two (2) groundwater samples (plus quality control samples) using the low flow purging and sampling method. The samples were submitted to a NJ-Certified lab for analysis of VO+TICS and SVO+TICS in accordance with NJDEPs analytical requirements for diesel fuel discharge areas.

The results of the initial and confirmation groundwater samples collected from monitoring well MW-4 indicated that volatile and semi-volatile organic compounds were not present at concentrations exceeding the GWQC. The details and results of the groundwater remedial investigation for AOC-B1 were reported to NJDEP in a *Groundwater Remedial Investigation Letter Report,* prepared by DRESDNER ROBIN, dated March 4, 2009. Based upon the recommendations of the RI Letter Report recommended, in a February 1, 2010 correspondence, NJDEP approved the March 2009 RI Letter Report and granted a No Further Action for groundwater at the Site.

C.2 Site Reconnaissance Reports

In response to proposed redevelopment of the Site for residential usage, USEPA's Brownfield's Coordinator initiated a Removal Site Evaluation for the property in June 2000. The site evaluation included the collection and analysis of soil samples from the courtyard and parking lot areas to confirm the presence of lead contamination. During the site evaluation, USTs containing waste oil and numerous drums were identified within the two buildings. The soil samples analyzed were reported to contain lead concentrations up to 7,900 parts per million (ppm). Upon authorization of CERCLA funding, removal activities were initiated by EPA on June 29, 2000. The removal actions included: 1) Excavation/off-site disposal of surface soils (<2 feet) with lead contamination exceeding 400 ppm; 2) removal and disposal of stored drums and their contents; and 3) the excavation and off-site disposal of USTs and their contents. The EPA removal actions were completed on September 22, 2010. EPA documentation of the activities stated that no further removal actions were anticipated for the Site.

C.3 Project Definition

The Site is planned for redevelopment as Cooper Grant Homes Phase II, which will consist of ten (10) residential townhomes, parking areas, access roadways, and a public park area. The results of site/remedial investigation activities indicate that contaminants are present in soil within the redevelopment areas that exceed the NJ Residential Direct Contract Soil Remediation Standards (RDCSRS). The contaminants of concern that were identified are: 1) site-wide metals and PAHS associated with historic fill materials; 2) tetrachloroethene (PCE) in a former Trench/Floor Drain/Piping Area (AOC-G) south of Building #1; and 3) possibly TPH and related contamination associated with No.2 Fuel Oil Tank excavation area (AOC-B2). The distribution of the contamination is shown on **Figure 9** of the RAW.

Based upon the recommendations of the RI/RAR and pursuant to N.J.A.C. 7:26E-4.3, the following sampling will be required prior to the start of construction activities:

1) Delineation sampling and/or post-excavation sampling for PCE in the vicinity of AOC-G;
2) Characterization/delineation sampling for possible TPH-impacted soil beneath AOC-B2 and/or post-excavation sampling.

The above sampling may be limited to post-excavation sampling if the Contractor elects to conduct a single-phase remediation (i.e., complete the remediation in one-mobilization).
In support of the redevelopment activities, the selected remedial strategy is as follows: 1) residential parcels - excavation of all historic fill materials (down to 12 feet) and replacement with clean fill materials; and 2) ROW/public areas- excavation of surface soils (approximately 1-foot) and placement of 2-feet of clean cap materials. The following sampling activities will be required for this strategy:

1) In-situ waste classification sampling prior to excavation of historic fill materials on the residential parcels;
2) In-situ waste classification prior to placement of engineering cap materials within the ROW/public use areas.

In-situ soil sampling was proposed in lieu of stockpile sampling due to the limited area that will be available for stockpiling at the Site during the construction activities. The waste characterization sampling will be necessary to determine the classification of the soil for transportation purposes (i.e., hazardous or non-hazardous) and to develop a soil profile for use by the disposal facility to determine the acceptability of the soil.

For development of this SAMP, the sampling protocols for historic fill materials as required by Clean Earth at their Philadelphia PA Disposal Facility were used. Actual sampling protocols used by the Contractor for waste characterization sampling may differ somewhat from those detailed in this SAMP and will be based upon the requirements of the selected disposal facility as approved by the Resident Engineer.

Based upon the No Further Action that was issued by NJDEP for groundwater the Site, groundwater sampling is not proposed in this SAMP. However, field data will be evaluated during the proposed remediation of AOC-G and AOC-B1 to determine if additional groundwater investigation is required to comply with the NJ Technical Requirement for Site Remediation.

D.0 Data Use Objectives

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, the data use objectives for the ABC Barrel Company Site Brownfield's SAMP are as follows:

- Verifying the attainment of clean-up goals. Ascertain if additional remediation is required.
- Completion of contaminant delineations for historic AOCs and estimating areas and volumes of soil for excavation and off-site disposal;
- Confirm the removal of contaminated soil for AOCs by post-excavation sampling;
- Characterizing soils for waste classification in support of excavation, transportation and off-site disposal (AOCs and historic fill materials)

D.1 Brownfields Site Investigation Reports

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, upon completion of the ABC Barrel Company Site Brownfields project, a Site Investigation Report will be developed. The Site Investigation Report will be submitted as part of the Remedial Action Report prepared pursuant to N.J.A.C. 7:26E-6.7 following completion of the remedial activities as detailed in the RAW. The Site Investigation Report will summarize the environmental condition of the property and recommend on ore more of the following:

- Conduct additional sampling, if required.
- Undertake additional remediation, if required
- No additional actions are required.

The Brownfields Site Investigation Report will present data to substantiate any of the aforementioned recommendations concerning the environmental condition of the property. As part of the selected remedial strategy as outlined in the RAW and approved by NJDEP, a Deed Notice will be filed with Camden County to function as administrative controls to address historic fill materials remaining at the site beneath the engineering cap.

D.2 Quality of Data Needed for Environmental Data Measuring

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, the Brownfields environmental measurement data will be of sufficient quality to ensure that sampling results accurately characterize site conditions. To ensure that Brownfields site investigation results provide an accurate characterization of environmental conditions at the property, this Site-Specific Brownfields SAMP is based upon and has incorporated the following:

- A detailed evaluation of historic site information (presented in the RAW)
- Selection of a sampling design that complies with NJDEP regulations
- Selection and utilization of suitable geophysical, analytical and sampling techniques
- Use of proper sample collection and preservation techniques.
- Collection and analysis of appropriate QA/QC samples.
- Logically present and interpret of analytical and geophysical data (if applicable).
- Definition of data usability criteria.

The Brownfields site investigation data will consist of in-situ field analytical/screening methods to identify physical evidence of contamination which may indicate the presence of chemical constituents and fixed laboratory analysis of samples. In-situ field analytical screening techniques that are likely be employed include use of Photo Ionization Detectors (PIDs) and identification of direct physical evidence of contamination in the sample through visual and olfactory means (staining, odor, sheen, etc.). Use of field screening techniques such as mixing of suspect soil with water to identify a sheen or "floating product' and other approved testing methods may be employed.

The screening methods will be employed as a tool for identifying potential contaminants of concern and will generally be used as a means to 'bias' the samples collected for fixed laboratory analysis. This will help assure that the sample results are biased towards the high end of the contamination concentration which is a conservative approach. The number of in-situ samples selected for laboratory analysis for contaminant delineation or for confirmation of removal of soils will be dictated by the applicable requirements of NJ's Technical Requirements for Site Remediation (the "Tech Regs"). For waste classification sampling, the frequency of samples collected for laboratory analysis (i.e., 1 sample peer 180 tons) will be as required by the selected receiving facility's sampling protocol. In general, the disposal facility sampling requirements will meet the minimum NJDEP guidelines or the facility will have an approved variance from NJDEP.

Samples submitted for laboratory analysis will utilize methodology that will assure that the specified U.S.EPA CLP quantitation levels will be achieved and that that quantitation levels will be below the applicable regulatory standards. Situations where this cannot be achieved due to the presence of gross contamination in the sample or from other causes will be addressed on case-by-case basis with the appropriate subject environmental regulatory agency(ies).

Surface geophysical techniques may be used to identify the location of unexpected objects such as buried tanks, drums, or other anomalies should thereby be encountered during the sampling or remedial construction activities. Qualified geophysical firms will be employed as needed that may use techniques that include ground penetrating radar (GPR), magnetometry, electromagnetic conductivity (EM) and resistivity surveys.

D.3 Project Description

This section of the Site-Specific Brownfields SAMP provides a detailed description of the work to be performed. The description identifies the media to be sampled, whether field or fixed laboratories or in-situ field analytical screening methods will be used, likely action levels, anticipated work schedules, required reports, and other appropriate information.

As identified in Section C3 of the SAMP, the project description is discussed separately for 1) characterization/delineation sampling and post-excavation sampling for AOCs requiring further remedial investigation pursuant to N.J.A.C. 7:26E; and 2) waste-classification sampling for historic landfill materials requiring off-site disposal following remediation of the residential parcels at the Site.

Characterization/Delineation Sampling and Post-Excavation Sampling

Tetrachloroethene (PCE) impacted soil identified in a former Trench/Floor Drain/Piping Area of the Site (AOC-G) requires further horizontal and vertical delineation. PCE was detected in post-excavation sample 06-PE-005 from 0.0 to 0.5 feet at a concentration of 520 mg/Kg adjacent to the south side of Building No. 1 as shown on **Figure 3 of the RAW**. Once the existing sample locations are identified in the field based upon GPS survey coordinates, continuous soil samples will be collected by the contractor (using direct push or other appropriate methods) and screened using a PID meter to determine the maximum depth of impact of the chlorinated solvents. The samples will also be inspected for physical evidence of contamination (visual and olfactory) to corroborate the PID readings. Samples will be collected from borings spaced 5 feet apart and discrete six-inch intervals (biased towards the greatest evidence of contamination) will be samples as necessary to vertically delineate the contamination. Samples will be submitted to a NJ-Certified fixed laboratory for analysis of PCE by Method 8260B.

Characterization/delineation sampling of petroleum related contamination is required in the vicinity of the No. 2 Fuel Oil Tank excavation area (AOC-B2). Field screening methods as described above and fixed laboratory analysis will be used for this sampling. Samples will be collected along the centerline of the former excavation at a depth corresponding to 0-6” below the bottom of the former excavation. If necessary, the contamination will be delineated horizontally and vertically as described above based upon the field screening data collected.

Following the delineation activities, the contractor will be required to excavate and remove the delineated contaminated soils and replace them with ‘clean’ certified fill materials compatible with the existing soils. To accomplish this, field screening methods will be used to excavate the contaminated soils and post excavation samples collected to confirm the contaminated soil removal. In general, NJDEP requirements for post-excavation sampling will be used that specify the collection of a minimum of one sample per 30 linear foot of sidewall and one sample per 900 feet bottom of bottom excavation area.

Waste Classification Sampling

Historic Fill materials are present underlying the entire Site down to a depth of approximately twelve (12) feet below existing grade. Historic investigations at the Site have shown that these materials consist of a mix of natural materials with some miscellaneous debris and contain individual PAHs and metals at concentrations that exceed NJ Residential Soil Remediation Standards. Sampling protocols will be utilized as required by the selected receiving facility to document that the incoming soils meet their NJDEP facility permit requirements. However, based upon NJDEP standard guidance, use of field screening methods will be required to bias the soil samples collected towards the greatest evidence of contamination. The soil samples collected will be submitted to a NJ Certified lab for analysis in accordance with the facilities approved analytical protocols which are expected to require collection of both discrete samples for NJ regulatory parameters and composite samples for EPA TCLP Extraction-Hazardous Waste Toxicity and RCRA Parameters. The receiving facility will evaluate all sampling data submitted for compliance with their standards/action levels before accepting the regulated waste.

Details of the field sampling and removal activities will be recorded in a dedicated field notebook and photodocumented. Chain of Custody documentation procedures for all samples will be strictly followed in accordance with the laboratory protocol. The field and analytical data for the delineation and post-excavation sampling will be summarized on field logs, field sampling summary tables, and analytical summary tables, and submitted with the Remedial Action Report of the remedial activities. The results of waste classification samples as submitted to the receiving facility are not typically submitted with the RAR, however, copies of all documentation related to the waste disposal such as soil profiles, facility approvals, disposal tickets, and related documents, will be submitted with the RAR.

D.4 Project Time Line

To ensure all sampling and analytical activities are performed in a correct and cost effective manner, it is beneficial to plot each phase of the site investigation effort. As a result, the progress of any environmental monitoring project should always be tracked from its inception, through implementation. Therefore, in this section of the Site-Specific Brownfields SAMP, an overall project timetable that outlines the beginning and ending times for the project, as well as, specific activities and products within the project is presented below. Since the exact start-up date of the project is not known and will depend upon the award of contract and receipt of the selected contractor's schedule, a weekly schedule is provided with no specific dates. Actual start and end dates of the project once determined, will be provided to NJEP/USEPA when available.

Activities *(Includes Products and/or Services)*	Dates *(MM/DD/YY)*	
	Activity Start Date	Activity End Date
Approval of RAW/award of contract	TBD	TBD
GPS Survey/Boring Stakeout/utility markouts	Week 2	Week 2
Soil Characterization/Delineation Sampling	Week 2	Week 2
Waste Classification Sampling	Week 3	Week 3
Laboratory Analysis	Week 4	Week 5
AOC Soil Excavation/Post-Ex Sampling	Week 6	Week 6
AOC Soil Off-Site Disposal	Week 8	Week 8
Remedial Excavation of Residential Parcels/Dewatering/ Off-site Disposal of Soil	Weeks 9	Week 12
Excavation for Placement of Engineering Cap/ Off-site Disposal of Contaminated	Week 13	Week 13
Site Restoration	Week 14	Week 15
Draft Remedial Action Report	Week 16	Week 22
Final Remedial Action Report	Week 23	Week 24
Final Deed Notice (Public Use Areas)	Week 24	Week 26

E.0 Sampling and Analysis

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, the purpose of performing a Brownfields site investigation is to determine the presence and identity of contaminants, as well as, the extent to which they have become integrated into the surrounding environment. The objective of this effort will be to collect and analyze environmental samples which are representative of the media under investigation. The methods and equipment used for collecting environmental matrices of concern will vary with the associated physical and chemical properties of the media designated for sampling.

To ensure sampling and analytical protocols are appropriate, it is necessary to describe the objectives and details comprising these activities. A s a result, the design of a proper sampling scheme, including protocols for collecting rinse blanks, trip blanks, duplicates, and background samples will be derived from an accepted guidance. As such, the U.S.EPA Superfund Program Representative Sampling Guidance, Volume 1: Soil 6 is included as attachments to this generic QAPP boilerplate. In addition, sampling and analysis protocols that are specifically applicable to NJ sites will be utilized, as specified in NJ's *Field Sampling Procedures Manual*, dated April 2006. These specific guides outline protocols for the collection of representative samples to ensure the accurate characterization of site conditions. Therefore, following these guides will assist in the design of a fitting sampling network which is thoroughly justified and documented in the corresponding Site-Specific Brownfields SAMP.

E.1 Sampling Design

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, this section of the Site-Specific Brownfields SAMP describes the sampling network design for the investigation of the ABC Barrel Company Site. The summary provides a rationale for the selection of sampling locations for each parameter/matrix to be sampled during the project. Field Quality Assurance Quality Control sample collection methods and procedures are also discussed which will confirm the accuracy of the field and analytical data.

Soil Characterization/Delineation Sampling

Horizontal and vertically delineation sampling for PCE for AOC-G (floor drain/trench piping) has been designed to satisfy the requirements of N.J.A.C. 7:26E:4.3 for remedial investigation of soils and to minimize the volume of contaminated soils that will have to be removed and disposed prior to the site redevelopment. To accomplish this, a horizontal soil boring/sampling spacing of 5 feet has been selected. The borings will be placed along perpendicular axis extending to the north, south, east, and west of initial boring 06-PE-005. The borings will be extended horizontally outward until no physical evidence of contamination is observed and PCE concentrations in the samples do not exceed of the NJ Residential Soil Remediation Standard of 2 mg/Kg. More than one mobilization for sampling may be required to achieve the soil standards. Vertical delineation will be achieved by collecting samples from each 2 foot interval starting from 0-6” that are biased towards the greatest evidence of contamination. A sample will be collected from the first interval that is ‘clean’ to confirm the vertical delineation including a sample below the groundwater table, if necessary. During the horizontal or vertical delineation, an interval may not be sampled if gross evidence of contamination is indicated, in which case the sampling will be collected from the next clean interval.

Soil characterization sampling for petroleum related constituents associated with AOC-B-1 (former 1,000-No. 2 Fuel Oil UST) has been designed to satisfy the requirements of N.J.A.C. 7:26E:3.9 (Site Investigation – Area Specific Requirements) for USTs and Table 2-1 (Analytical Requirements for Petroleum Discharge Sites) of the 'Tech Regs'. To comply with these requirements, four (4) soil samples will be collected at 0-6" below the bottom of the former UST along the centerline of the excavation. The samples will be analyzed for extractable petroleum hydrocarbons (EPH) and naphthalene and 2-methylnaphthalene, in accordance with NJDEP Guidance for No. 2 Fuel Oil USTs at residential sites as presented in "Protocol for Addressing Extractable Petroleum Hydrocarbons", dated August 9, 2010. If the analytical results indicate that any constituent is found to exceed the NJ Residential Soil Remediation Standards, than a remedial investigation will be conducted as necessary pursuant to N.J.A.C. 7:26E-4.

The locations of the proposed soil characterization and delineation sampling for AOC-G and AOC-B-2 are shown on **Figure 7 of the RAW**. A Sampling Summary is provided in **Table 2 of the RAW**.

Waste Classification Sampling

Sampling protocols from Clean Earth of Philadelphia for historic fill materials have been used to complete this section of the RAW and to support preparation of bid specifications for the project. Although the remediation contractor has not yet been selected, he may elect to use a different facility. However, the sampling frequency and required analysis for different facilities accepting non-grossly contaminated historic fills should be similar as they must comply with NJDEP's minimum requirements.

In-situ waste classification has been selected for the project because of the limited space available at the Site for management of soil stockpiles. The frequency of waste classification samples was estimated by dividing the required number of characterization samples for each ton of waste [i.e., 1 grab sample per 180 tons for EPH, semi-volatiles, and volatiles; and one 5-part composite sample per 900 tons for PCBs, metals, sulfur, TCLP (excluding volatiles) and RCRA Parameters] by the volume of historic fill materials to be excavated from each parcel.

Considering the above sampling requirements, the following numbers of waste classification samples were estimated: Block 62 Lots 1-4: 8 samples each; Block 62 Lots 11-14: 12 samples each; Block 62 Lots 38 & 40: 4 samples each; public areas (required for engineering cap placement): 9 samples total. To satisfy the above frequency of samples, a total of twenty-two (22) borings will be advanced on the residential parcels and four (4) samples will be collected in each boring (one sample form each 2 foot interval from 0 to 12 feet below existing grade). Nine shallow subsurface samples (0 to 1 feet) will be collected from the public use areas prior to the required excavation for placement of the engineering cap. surface samples. The proposed boring/sampling locations were placed systematically within the area of the parcel/ROW being excavated.

The locations of the proposed waste classification samples are shown in **Figure 8 of the RAW** and a sampling summary is provided as **Table 3 of the RAW**.

F-1.0 Standard Operating Procedures

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, applicable and available Standard Operating Procedures (SOPs) will be incorporated into the overall data collection activities for the ABC Barrel Company Brownfields site investigation. Based upon the scope of the proposed activities, the following SOPs are incorporated into the SAMP:

- Sampling and analytical methodologies.
- Field equipment selection and use.
- Field equipment calibration and standardization.
- Field equipment preventive maintenance.
- QC procedures for intra-laboratory and intra-field activities.
- Data validation.
- Document control procedures.

F-1.1 Sampling SOPs

To ensure environmental sample collection efforts are representative of site conditions, accepted SOPs will be utilized to optimize the sampling activities. Sampling SOPs are typically proven protocols which may be varied or changed, as required, depending upon site conditions and/or equipment limitations imposed by the procedure. The sampling procedures which will be employed to collect environmental samples for the ABC Barrel Company site investigation are documented in this Site-Specific Brownfields SAMP.

To facilitate the selection of appropriate sample collection techniques, the sampling SOPs employed for this site-specific Brownfields investigation are derived from an accepted guide. As such, the *U.S.EPA Compendia of Emergency Response Team (ERT) Sampling Procedures* including Soil Sampling and Surface Geophysics Procedures 9, Surface Water and Sediment Sampling Procedures 10, and Groundwater Sampling Procedures 11 are included as attachments to this SAMP. These media specific sampling protocols are the U.S.EPA's accepted SOPs for collecting potentially contaminated environmental matrices of concern such as soil and water. Therefore, to optimize sample collection efforts, these protocols will be used in conjunction with the Superfund Program Representative Sampling Guidances.

F-1.2 SOP Reference Table

ANALYTICAL METHOD REFERENCE (*Include document title, method name/number, revision number, date)*
1a. USEPA 1999 *Contract Laboratory Protocol Statement of Work for Organics Analysis, Multi-media, Multi-Concentration,* OLM0 4.2 Office of Emergency and Remedial Response, Washington DC. SOP is part of the QAPP.
2a. USEPA 1999 *Contract Laboratory Protocol Statement of Work for Inorganics Analysis, Multi-media, Multi-Concentration,* ILM0 4.0 Office of Emergency and Remedial Response, Washington DC. SOP is part of the QAPP.
3a. 4. U.S. Environmental Protection Agency *Test Method 1311- Toxicity Characteristic Leaching Procedure,* Environmental Health & Safety Online, Rev. July 1992 (incorporated by reference).
4a. New Jersey Department of Environmental Protection, *Extractable Petroleum Hydrocarbon Methodology*, Document # NJDEP EPH 10/08, August 2010, Rev 3. (Incorporated by reference)
PROJECT ANALYTICAL SOPs (*Include document title, date, revision number, and originator=s name)*
1b. MiniRAE 2000 Portable VOC Monitor, *Operation and Maintenance Manual*, Rev. May 2005, PGM-7600 **(ATTACHMENT A)**
2b. 4c. New Jersey Department of Environmental Protection Site Remediation Program, *Protocol For Addressing Extractable Petroleum Hydrocarbons* , Version 5, August 9, 2010 (incorporated by reference)
3b. New Jersey Department of Environmental Protection Site Remediation Program, *Low-Flow Purging and Sampling Guidance*, Dec. 2003 (incorporated by reference)
4b. *Field Soil Boring/Rock Coring Logging Procedures and Classification Systems*, Dresdner Robin, Sept, 2003 **(Attachment B)**
5b. Quality Assurance Manual for Selected Laboratory- to be provided by the Contractor upon award of contract
PROJECT SAMPLING SOPs [1] (*Include document title, date, revision number, and originator=s name)*
1c. *U.S.EPA Compendia of Emergency Response Team (ERT) Sampling Procedures* including Soil Sampling and Surface Geophysics Procedures 9, Surface Water and Sediment Sampling Procedures 10, and Groundwater Sampling Procedures 11. This SOP is part of the Generic Brownfields QAPP.
2c.*Samplers Guide to Contract Laboratory Program* 9240-30, prepared by USEPA. Part of the Generic Brownfield QAPP.
3c. NJDEP *Field Sampling Procedures Manual*, August 2005 (incorporated by reference)
4c. USEPA Region 4- SOP *Field Equipment Cleaning and Decontamination*, SESDPROC-205-R1, Nov. 2007 **(ATTACHEMNT C)**
5c. USEPA Region 4- SOP *Management of Investigation Derived Waste* SESDPROC-202-R2, October 2010 **(ATTACHEMNT D)**
6c. USEPA Region 4- SOP *Soil Sampling*, SESDPROC-300-R1, Nov. 2007 **(ATTACHEMNT E)**
7c. USEPA Region 4- SOP *Field Sampling Quality Control* SESDPROC-011-R3, October 2010 **(ATTACHEMNT F)**
[1] Project Sampling SOPs include sample collection, sample preservation, equipment decontamination, preventive maintenance, etc...

F-2.0 Sampling and Analytical Parameters

Matrix (Sample Type)[1]	Number of Samples[2]	Sampling SOP[3]	Parameter/Fraction	Minimum Sample Volume[4]	Sample Container[5]	Sample Preservation	Analytical Method[6]	CLP Contractual Reporting Limit	Technical Holding Time
									(extract/analyze)
Soil			Target Compound List						
	46	1a	(TCL): Volatile Organics (VOCs)	4 oz.	2 oz./4 oz. clear wide-mouth glass with Teflon lined septum.	Cool to 4EC	OLM0 4.2	10 ug/kg	14 days
	100	1a	Acid Extractable Organics Base & Neutral Organics (BNAs)	4 oz.	4 oz. amber wide-mouth glass with Teflon lined cap.	Cool to 4EC	OLM0 4.2	Compound Specific (330-830 ug/kg)	7 days / 40 days
	33	2a	Pesticides/Aroclors	4 oz.	8 oz. clear wide-mouth glass with Teflon lined cap.	Cool to 4EC	ILM0 4.0	Compound Specific (1.7-170 ug/kg)	7 days/ 40 days
	33	2a	(PCBs) Target	6 oz.	**8 oz. clear wide**-mouth glass with Teflon lined cap	Cool to 4EC	ILM0 4.0	Analyte Specific (0.2-5000 ug/L)	180 days; (28 days Hg)
			Analyte List (TAL):						
			Total Metals						
	105	4a	TPH/EPH	6 oz	4 oz. amber wide-mouth glass w/silicone-lined cap	Cool to 4EC	NJDEP-EPH 10/08	10,000 ug/L (each carbon range)	14 days/ 40 days
	variable	4a	Naphthalene & 2-Methylnaphthalene	4 oz.	4 oz. amber wide-mouth glass with Teflon lined cap.	Cool to 4EC	OLM0 4.2 OLM0 4.2	Compound Specific	7 days;

F-2.0 Sampling and Analytical Parameters

Matrix (Sample Type)[1]	Number of Samples[2]	Sampling SOP[3]	Parameter/Fraction	Minimum Sample Volume[4]	Sample Container[5]	Sample Preservation	Analytical Method[6]	CLP Contractual Reporting Limit	Technical Holding Time (Extract/Analyze)
			TCLP Parameters (TCLP):						
Soil	25	3a	Volatile Organics (VOCs)	200 g	16 oz. clear wide-mouth glass with Teflon lined cap.	Cool to 4EC	EPA- 1311	Compound Specific	14 days
	25	3a	Semivolatile Organics	500 g	16 oz. clear wide-mouth glass with Teflon lined cap.	Cool to 4EC	EPA- 1311	Compound Specific	14 days /40 days
	25	3a	Mercury/Metals	500 g	16 oz. clear wide-mouth glass with Teflon lined cap. .	Cool to 4EC	EPA- 1311	Compound Specific	28days; /180 days
	25	3a	RCRA Characteristics/ Flashpoint, Corrosivity	500 g .	16 oz. clear wide-mouth glass with Teflon lined cap.	Cool to 4EC	EPA- 1311	NA	NA

F-2.0 Sampling and Analytical Parameters

Matrix (Sample Type)[1]	Number of Samples[2]	Sampling SOP[3]	Parameter/Fraction	Minimum Sample Volume[4]	Sample Container[5]	Sample Preservation	Analytical Method[6]	CLP Contractual Reporting Limit	Technical Holding Time
Aqueous (ground-water)	0-4	1a	Target Compound List (TCL): Volatile Organics (VOCs)	80 ml	40 ml VOC vial with Teflon lined septum.	1:1 HCl to pH<2; Cool to 4EC; 25 mg Ascorbic Acid[7]	OLM0 4.2	10 ug/L	14 days
	0-4	1a	Acid Extractable Organics Base & Neutral Organics (BNAs)	2 Liters	1 Liter amber glass with Teflon lined cap.	Cool to 4EC; 80 mg $Na_2S_2O_3$ (sodium thiosulfate)[8]	OLM0 4.2	Compound Specific (10 - 25 ug/L)	7 days extract; 40 days analyze
	0	2a	Pesticides/Aroclors (PCBs)	2 Liters	1 Liter amber glass with Teflon lined cap.	Cool to 4EC	OLM0 4.2	Compound Specific (0.05-5.0 ug/L)	7 days extract; 40 days analyze
	0	2a	Target Analyte List (TAL): Total Metals	1 Liters	1 Liter HDPE bottle with Teflon lined cap.	1N HNO_3 to pH<2; Cool to 4EC	ILM0 4.0	Analyte Specific (0.2-5000 ug/L)	180 days (28 days Hg)
	0	2a	Cyanide	1 Liters	1 Liter HDPE bottle with Teflon lined cap.	NaOH to pH>12; Cool to 4EC; 25 mg Ascorbic Acid[8]	ILM0 4.0	10 ug/L	14 days[9]

G.0 Preventative Maintenance - Field Equipment

The purpose of this section is to delineate the SOPs/methods which will be utilized to ensure that all field equipment will function in an optimum manner. This summary references all pertinent SOPs/methods for performing these activities. Also, include a brief description of each specified procedure along with the frequency of application for employing these methods.

The field photoionization detection meter (PID) is to be utilized for soil screening during sampling and excavation activities. The PID will be provided by an equipment vendor who will perform initial calibrations and maintenance prior to delivery of the equipment to the site. The vendor's will provide upon request a record of the PID maintenance and calibration with the instrument to document the maintenance/calibration procedure. In addition, the environmental inspector will perform daily calibrations while in receipt of the instrument, typically in the morning prior to use, as well as routine maintenance based upon the operating efficiency of the unit in the field. The calibrations will utilize the calibration gas as supplied by the vendor. The operation, calibration, and routine maintenance of the PID are to follow the manufacturer's recommended procedures as provided in SOP Reference #1b in Attachment A of the SAMP. A record of the daily field calibrations and routine maintenance will to be kept in the dedicated project field notebook.

When the instrument is in need of repair, the vendor will be contacted to pick up the instrument and provide a replacement instrument that has been calibrated and maintained. Because the vendor is likely to have on hand an adequate supply of PIDs, problems with obtaining spare parts or any significant instrument repair issues should be minimized.

Instrument	Activity	Frequency	SOP Reference[1]
Portable Photoionization Detector (PID)	Soil Screening for VOCs	Daily or as needed	1b

[1] Insert the appropriate reference number/letter from Form F-1, Method and SOP Reference Table.

H.0 Calibration and Corrective Action - Field Equipment

The purpose of this section is to delineate the SOPs/methods which will be used to ensure that all field equipment calibration and corrective actions will be performed in a proper manner. This summary references the pertinent SOPs/methods for performing these activities. It should also include a brief description of each specified procedure along with the frequency of application for employing these methods. In conjunction, it is essential that these activities should always be recorded in a log book.

Performing instrument calibration is a necessary function which ensures the accuracy and precision of field testing equipment. Subsequently, the following procedures should always be implemented when calibrating field instrumentation:

- Reference the applicable SOP or provide a written description of the calibration procedure(s) used for each field measurement system.
- List the frequency planned for re-calibration and/or the criteria, including acceptance limits, utilized to dictate the frequency of re-libration.
- List the calibration standards to be used and their source(s), including traceability procedures.

Corrective actions are the processes for rectifying a field measurement system which is not operating within specified control limits. These techniques which facilitate the collection of representative field measurement data should always include the following information:

- The pre-determined limits for data acceptability beyond which corrective action is required.
- Procedures for corrective actions.
- Identity the individuals responsible for initiating and approving the implementation of corrective actions for each measurement system.

Therefore, in this section of the Site-Specific Brownfields SAMP, identify all tools, gauges, and equipment for field screening data collection efforts which require calibration to operate within specified limits. Reference all calibration procedures using certified equipment and standards with recognized performance criteria. In addition, specify the procedures for maintaining calibration and corrective action records.

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Reference[1]
Photoionization Meter	Calibrate with standard gas	Daily or as needed	Reading equal to Standard concentration	Adjust span knob until reading equals standard	1b
Photoionization Meter	Zero meter	Daily or as needed	Reading equal to zero after checking standard gas	Adjust zero control knob until reading equals zero	1b

[1] **Insert the appropriate reference number/letter from Form F-1, Method and SOP Reference Table.**

I.0 Preventive Maintenance - Laboratory Equipment

The purpose of this section is to delineate the SOPs/methods used to ensure the optimum performance of laboratory equipment. It is essential that the frequency and application of these methods be appropriately recorded in a log book. In conjunction, it is advantageous to provide a schedule of all the routine preventive maintenance tasks which will be performed to minimize laboratory instrument downtime. It is customary that these SOPs/methods note and address all critical spare parts that shouldbe on hand to minimize instrument downtime.

All laboratory equipment should be maintained in accordance with each respective instrument manufacturer's operating instructions with all maintenance activities recorded in a log book. Each equipment log book should remain with instrument except when it is sent out for repairs. This equipment log book is useful in tracking records of usage, maintenance, and repairs.

Therefore, in this section of the Site-Specific Brownfields SAMP (when applicable), identify the laboratory equipment and/or systems requiring periodic preventive maintenance. Cite references on how periodic preventive and corrective maintenance of equipment shall be performed to ensure availability and satisfactory performance. Likewise, specify how the availability of critical spare parts which are identified in the instrument manufacturer's operating instructions and/or SOPs will be assured and maintained.

Instrument	Activity	Frequency	SOP Reference[1]
To be provided by the selected contractor's laboratory			

[1] Insert the appropriate reference number/letter from Form F-1, Method and SOP Reference Table.

J.0 Calibration and Corrective Action - Laboratory Equipment

The purpose of this section of the SAMP is to delineate the analytical techniques that will ensure the laboratory instrumentation employed will accurately and precisely quantitate the target analytes of concern.

The analytical laboratory selected by the contractor will provide this information for all target the compound list parameters such that the data objectives of this SAMP are supported. The protocol will follow the USEPA-*Contract Laboratory Protocol OLMO 4.1 for inorganic analytes* and the USEPA-*Contract Laboratory Protocol OLMO 4.2 for organic analytes*. Additionally, the selected analytical laboratory will be required to submit and follow their approved Quality Assurance Manual, including calibration corrective action procedures for the laboratory equipment.

K.0 Sample Documentation and Handling

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, an essential element of any Brownfields sampling/analytical scheme is to maintain sample integrity from collection to data reporting. This involves tracing the possession and handling of samples from the time of collection through analysis and final disposition. The documentation used to track a sample's history is referred to as the "chain-of-custody." To facilitate sample chain-of-custody efforts, it is essential to record all inspections, investigations, and photographs which are taken, as well as, perform a thorough review of all notes before leaving the site.

To promote the management of sample integrity, it is important that all parties involved understand that a sample is considered to be under a person's custody if; (a) it is in a person's physical possession, (b) in view of that person after he/she has taken possession, (c) secured by that person so that no one can tamper with the sample, or (d) secured by that person in an area which is restricted to authorized personnel. A person who has samples under their custody must always comply with these procedures in order to assure sample integrity.

K.1 Sample Documentation

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, all sample documents should always be legibly written in ink. Any corrections or revisions to sample documentation shall be made by lining through the original entry and initialing any changes. To elaborate on these requirements, the following sub-sections are provided to outline sample documentation procedures which should be employed when conducting a Brownfields investigation.

K.1.1 Field Logbook

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, the field logbook is a descriptive notebook detailing site activities and observations so that an accurate and factual account of field procedures may be reconstructed. All entries should be signed by the individuals who are making them. Nonetheless, all field logbook entries should always document the following specific information:

- Site name and project number.
- Contractor name and address.
- Names of personnel on site.
- Dates and times of all entries.
- Descriptions of all site activities, including site entry and exit times.
- Noteworthy events and discussions.
- Weather conditions.
- Site observations.
- Identification and description of samples and locations.
- Subcontractor information and names of on-site personnel.

- Dates and times of sample collections and chain of custody information.
- Records of photographs.
- Site sketches.
- All relevant and appropriate information delineated in field data sheets and sample labels.

K.1.2 Field Data Sheets and Sample Labels

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, field data sheets, along with corresponding sample labels, are routinely used to identify samples and document field sampling conditions and activities. Field data sheets should be completed at the time of sample collection and should always include the following information:

- Site name.
- Contractor name and address.
- Samplers name.
- Sample location and sample identification number.
- Date and time the sample was collected.
- Type of sample collected.
- Brief description of the site.
- Weather conditions.
- Analyses to be performed.
- Sample container, preservation, and storage information.

Sample labels are always to be securely affixed to the sample container. They must always clearly identify the particular sample, and delineate the following information:

- Site name and designated project number.
- Sample identification number.
- Date and time the sample was collected.
- Sample preservation method.
- Sample pH.
- Analysis requested.
- Sampling location.

K.1.3 Chain of Custody Record

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, a chain-of-custody record must always be maintained from the time of sample collection until final deposition. Every transfer of custody will be noted and signed for with a copy of the record being kept for each individual which endorsed it. It is integral that the chain-of-custody record should always include the following information:

- Contractor name and address.
- Sample identification number.
- Sample location.
- Sample collection date and time.
- Sample information (matrix type, number of bottles collected, container type, etc).
- Names and signatures of samplers.
- Signatures of all individuals who have had custody of the samples.

K.1.4 Custody Seals

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, custody seals are used to demonstrate that a sample container has not been opened or tampered with. The individual who has sample custody shall always sign, date, and affix the custody seal to the sample container in such a manner that it cannot be opened unless it is broken. When samples are not under direct control of the individual currently responsible for them, they will be stored in a locked container which is also to be affixed with a custody seal.

K.2 Sample Handling and Shipment

It is customary for field sampling personnel to always transport environmental samples directly to the laboratory within 24 hours of sample collection. To assist in these efforts, field sampling personnel will either utilize an overnight delivery service within 24 hours of sample collection or will transport them to the laboratory directory.

When preparing sample containers for shipment they must always be securely closed with a custody seal affixed to each cap. All sample containers will be labeled as described above. Subsequently, they are to be placed in an appropriate transport container and packed with an absorbent material such as vermiculite. All sample containers will be packed with ice to maintain a temperature of 4°C. All sample documentation will then be affixed to the underside of each transport container lid. T he transport container lid will then be closed and affixed with a custody seal accordingly.

Regulations for packaging, marking/labeling, and shipping hazardous materials and wastes are issued by the U.S. Department of Transportation (U.S. DOT). Air carriers which transport hazardous materials, such as Federal Express, may also require compliance with the current edition of the International Air Transport Association (IATA) Dangerous Goods Regulations.

The IATA protocol details the procedures for the shipment and transportation of hazardous materials by a common air carrier. All current IATA regulations will be followed to ensure compliance with U.S. DOT protocol.

K.3 Sample Handling and Chain of Custody Requirements

All samples collected as part of this SAMP will be collected in the appropriate laboratory supplied containers. The containers will comply with the USEPA Specification and Guidance for Contaminant-Free Sample Containers, OSWER Directive #92405.05A, EPA 540/R-93/051. The sample containers will be appropriately labeled, identified on the Chain of Custody and placed in a cooler with ice packs. Subsequently, at the end of the field work for that day, the samples will be shipped via overnight mail or delivered to the selected analytical laboratory accompanied by the completed Chain-of-Custody. Examples of Chain-of-Custody forms, labels, and custody seals will be provided by the selected laboratory after their selection.

All samples will be assigned unique sample numbers in the following manner:

- Site Identification (S = Scolite, I = IDA)
- Boring Number: 1,2,3,…
- Sample Interval: e.g. 0-0.5’

Soil samples to be field screened will be obtained according to the appropriate SOP, such as:

- Subsurface Sampling With A Split Spoon (3c).
- Soil Sampling With A Hand Augur (2c).

All samples will be placed in a resealable plastic bag. All samples will be labeled with the sampling date, the sample location and sample interval, and the collection method. All information regarding samples will be logged in the field notes. At each sampling location, the bags will be temporarily stored in a specified area for field screening. The bags from a boring will be field screened with the PID after all samples have been collected from that boring. The PID readings will be accomplished according to SOPs 1b and 3b. Once all the field readings have been taken, the unused soil samples will be emptied into the boring hole. All empty sampling bags will be disposed of as non-hazardous waste.

A sufficient amount of soil will be collected for each of the analytical parameters to be determined twice by the specified analytical methods according to the specified protocol. This will ensure that a re-analysis can be performed if necessary. Samples destined for organic compound analysis will be placed in glass jars to prevent the plasticizers and other organic compounds found in plastics from contaminating the samples.

Appropriate preservation by cold temperature storage at 4˚C will be utilized to ensure that the analytical parameters are not affected by the time the sample reaches the analytical laboratory. Samples will be analyzed prior to the applicable holding time each analytical parameter.

All sample handling in the field and transportation will conform to the sample custody procedures. Field custody procedures include proper sample labeling, chain-of-custody forms, and packaging and shipping procedures. Sample labels will be attached to all sampling bottles before each sampling day's effort to ensure that proper sample identification is maintained. As noted earlier, each label will identify the sampling site and sample location.

Each sample cooler will be lined with two plastic bags of 6 mil thickness. Styrofoam, bubble wrap or empty plastic bottles will be used to fill up empty space in each cooler and prevent breakage of containers during handling and transport. Ice packs, ice in bottles, or ice will be placed in between the plastic lining bags to accomplish sample preservation.

After each sample is packaged and labeled, the following information will be recorded on the chain-of-custody form:

1. Site name and address
2. Sampler(s)' name(s) and signature(s)
3. Names and signatures of the persons involved in the chain of possession of the samples
4. Sample number
5. Number of containers
6. Sample location
7. Date and time of collection
8. Type of sample, sample matrix (soil) and analysis requested
9. Any pertinent field data collected (PID reading)

The sampler will:

- Sign and date the "Relinquished" space,
- Remove one copy of the chain-of-custody form,
- Seal the remaining copies of the form in a resealable plastic bag, and,
- Tape the bag containing the chain-of-custody form to the underside of the sample cooler lid.

When the sample cooler is filled with sample containers and the chain-of-custody form has been filled out fully and affixed to the underside of the lid, the 6 mil plastic bags will be sealed around the samples by twisting the top and securely taping each bag closed to prevent leaking. A sample custody seal will be placed around the outer bag which will include the signature of the project manager or his/her designee, and the date and time.

The sample cooler itself will be sealed with tape prior to shipment to the laboratory. Custody seals will be placed spanning the cooler lid and cooler base in such a manner to make unauthorized tampering visible during transport, but especially at the laboratory. These seals will include the signature of the project manager or his designee and the date and time. Further details for the above procedures are given in SOPs 6c, 7c, and 8c (see SOP Reference Table F-1.2).

L.0 Analytical Data Quality Requirements and Assessments

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, an important aspect in the Brownfields project planning process is to define what levels of data are required. T hese data quality requirements are to be based on a common understanding of its intended use, the complexity of the measurement process, and the availability of resources. Once data quality requirements are clearly determined, QC protocols are to be defined for measuring whether these environmental monitoring acceptance/performance criteria are being met.

L.1 Data Acceptance/Performance Criteria

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, when conducting a Brownfields site investigation, it is essential to collect data which are of sufficient quantity and quality to support accurate decision making. The most effective way to accomplish these objectives is to determine the type, quantity, and quality of environmental measurement data which are necessary to achieve monitoring goals prior to the commencement of sampling. To assure the level of detail is commensurate with the objectives of a Brownfields site investigation, a common sense "systematic planning" approach should be followed. This process is useful in promoting the development of "acceptance and/or performance criteria" for gauging the collection, evaluation, and use of environmental measurement data.

Data "acceptance and/or performance criteria" are prerequisites established to specify the quality of Brownfields site investigation environmental monitoring results required to support decisions. Data acceptance/performance criteria are predicated in accordance with the anticipated end uses of the information which are to be collected. The establishment of data acceptance/performance criteria are applicable to all phases and aspects of the remediation process including site investigation, design, construction, and clean up operations. It is important to note that the level of detail and quality needed will often vary with the intended use of the data. Consequently, in most instances QA/QC activities involving precision and accuracy determinations are relied upon to assess acceptance/performance criteria.

L.2 Analytical Precision

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, analytical precision measurements are typically determined when performing instrumental analyses to assess the errors associated with analyte interferences, sample heterogeneity, and poor laboratory practices. They are commonly undertaken by incorporating matrix spike, matrix spike duplicate, and/or matrix duplicate quality control sample analyses into the analytical scheme. Precision measures are often best expressed by calculating the Relative Percent Difference (RPD) between a sample and its duplicate determination. The Relative Percent Difference (RPD) between the two results will be calculated as follows and used as an indication of the precision of the analyses performed:

$$RPD = \frac{[S - D] \times 100}{(S + D/2}$$

S= Sample
D=Duplicate
{ }= Indicates absolute value of the difference to Express RPD as a positive value

L.3 Analytical Accuracy

Analytical accuracy determinations are typically undertaken when performing instrumental analyses to assess the proficiency of the measurement process. They are commonly undertaken by incorporating calibration verification, method blank, calibration blank, method control, surrogate spike, and/or matrix spike quality control sample analyses into the analytical scheme. Accuracy measures are often best expressed by calculating the Percent Recovery (%R) between true and found values as follows:

$$\% R = A/B \times 100$$

A = found analyte concentration determined experimentally.
B = true analyte concentration.

L.4 Analytical Precision and Accuracy Requirements

This section delineates the analytical techniques for ensuring the laboratory equipment employed will accurately and precisely quantitate each target analyte of concern. Therefore, the selected analytical laboratory will provide this information for all the target compound list of parameters such that the data objectives of this SAMP are supported. The protocol will follow the *USEPA – Contract Laboratory Protocol OLMO 4.1* for inorganic analytes and the *USEPA - Contract Laboratory Protocol OLMO 4.2* for organic analytes. Also, the selected analytical laboratory will be required to submit and follow their approved Quality Assurance Manual and laboratory SOPs for all analytical procedures employed by the laboratory, especially with regards to obtaining the proper analytical precision and accuracy. These documents will identify the analytical methods and equipment required, including sub-sampling or extraction methods, laboratory decontamination procedures and materials, waste disposal requirements (if any), and specific performance requirements (quantitation levels, precision limits, accuracy limits, etc.) for each method. These requirements are summarized in the following sub-sections of this SAMP for all fixed laboratory confirmatory and in-situ field screening analyses which will be undertaken in this site-specific Brownfields investigation.

L.4.1 Fixed Laboratory Precision and Accuracy Requirements

The analytical precision and accuracy protocols will be conducted in accordance with the appropriate USEPA CLP SOW. The **USEPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration OLM0 4.2** or latest revision will be used for TCL determinations. The **USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration ILM0 4.0** or latest revision will be used for TAL determinations. Also, the SOPs of the selected analytical laboratory will specify the precision and accuracy protocols that will be followed within the use of the USEPA documents mentioned above.

L.4.2 In-situ Field Analytical Precision and Accuracy Requirements

The precision and accuracy of the portable PID will be ensured in conformance with SOPs 1b and 3c (see reference Table F.1.2).

These SOPs include the following QA/QC protocols:

- Field screening procedures – SOP-36: sector 6.26 of NJ Field Sampling Procedures Manual.
- Sample documentation (recording sample collection location, time and date, and associated field measurements, etc.).
- Field analytical screening documentation (providing raw data, calculations, and final results for the field screening analysis of all environmental and accompanying QC samples).
- Method calibration (requiring the initial and continuing calibration of all field analytical instrumentation according to the instrument manufacturer's operating instructions).

Please refer to the SOPs for further detail

M.0 Data Measurement Quality Objectives

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, when conducting a Brownfields site investigation, all measurements should be made so that results are reflective of the environmental media and conditions being measured. To assess if environmental monitoring measurements are of an appropriate quality, "acceptance and/or performance criteria" are typically established. Acceptance/performance criteria are commonly assessed by evaluating thePrecision, Accuracy, Representativeness, Completeness, and Comparability (PARCC) of pertinent QA/QC options specified for sampling and analytical activities.

- Precision; a measure of the reproducibility of analyses under a given set or conditions.
- Accuracy; a measure of the bias that exists in a measurement system.
- Representativeness; the degree sampling data accurately and precisely depict selected haracteristics.
- Completeness; the measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under "normal" conditions.
- Comparability; the degree of confidence with which one data set can be compared to another.

M.1 Sample Collection Precision

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate,sample collection precision is customarily assessed by collecting field duplicate samples. Field duplicate samples are used to evaluate errors associated with sample heterogeneity, sampling methodology and analytical procedures. T he analytical results from these samples are important because they provide data to evaluate overall measurement precision.

M.2 Sample Collection Accuracy

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, to assess sample accuracy, field QC samples such as rinsate, trip, and/or field blanks, are typically incorporated into the sampling scheme. The data acquired from the analysis of blanks are useful in their ability to evaluate errors which can arise from cross-contamination. The occurrence of cross- contamination can result from the improper handling of samples by field and/or lab personnel, improper decontamination procedures, improper shipment and storage, and on-site atmospheric contaminants. Therefore, to facilitate sample collection accuracy, it is essential to maintain the frequent and thorough review of field procedures so that deficiencies can be quickly documented and corrected.

M.3 Sample Collection Representativeness

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, representativeness is an expression of the degree to which a sample accurately and precisely represents a characteristic of a population, parameter variations at a sampling point or an environmental condition.

Representativeness is a qualitative parameter which relies upon the proper design of a fitting sampling program and proper laboratory protocol. This criterion is best satisfied by making certain that sampling locations are selected properly and a sufficient number of samples are collected. Therefore, sample representativeness will be assessed by collecting field duplicates. T raditionally, field duplicates are by definition, equally representative of a given point in space and time.

M.4 Sample Collection Comparability

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, comparability is defined as an expression of the confidence with which one data set can be compared to another. In most instances, the proficiency of field sampling efforts will be the determining factor which affects the overall comparability of environmental measurement data. To optimize the comparability of environmental measurement data, sample collection activities should always be performed using standardized procedures whenever possible. When performing a Brownfields site investigation, these efforts will be facilitated by adhering to the quality control criteria and technical guidelines put forth in this QAPP boilerplate.

M.5 Sample Collection Completeness

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, completeness is defined as the measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions. Data completeness is often expressed as the percentage of valid data obtained from a given measurement system. To consider data valid, it is customary to assess if a set of data satisfies all of the specified acceptance/performance criteria (accuracy measures, precision measures, etc.) to render a determination. This necessitates that the data acquired for all confirmatory analyses critical to a Brownfields site investigation sampling program be validated (100%). Therefore, by performing a full data validation effort to ensure completeness, the rationale for considering data points non-critical will not be not required. However, for the ABC Barrel Company Site, for waste classification sampling data, the data validation effort performed will be consistent with the requirements of the selected receiving facility.

M.6 Sampling Quality Control Requirements

Quality control procedures (checks and audit samples) with specified acceptance/performance limits are always to be used when conducting a Brownfields site investigation to monitor sampling operations. In this section of the Site-Specific Brownfields SAMP, the respective sampling quality control activities which will be employed when conducting the investigation of a particular property are summarized. To assist in the design of an appropriate quality control program to monitor Brownfields site investigation sampling activities, the New Jersey's regulations pertaining to quality assurance for sampling and laboratory analysis are followed (N.J.A.C. 7:26E-2).

To facilitate the documentation of a program to monitor sample collection operations, the following field sampling QC procedures are to be used:

QC Sample	Frequency	Acceptance Criteria	Corrective Action
Field Quality Control Requirements			
Field Duplicate	20% per parameter per matrix or minimum one per event	Relative %Difference (RPD)<50%	Sampling techniques, sample media, and analytical procedures will be examined
Collocated Sample	NA	-	-
Split Sample	NA	-	-
Equipment Rinsate Blank[2]	20% per parameter per matrix per equipment type per decontamination event or minimum 1 per event	No target analytes> 5x the detection limit (10x for common lab contaminants)	Equipment decontamination procedures will be reviewed
VOA Trip Blank	1 per cooler	No target analytes> 5x the detection limit (10x for common lab contaminants)	Sampling techniques, sample media, and analytical procedures will be examined
Other (*Specify*)	-	-	-
Legend: [1] Applicable to soil/sediment matrices only. [2] Applicable to groundwater/surface water matrices only.			

N.0 Data Reporting

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, it is essential to the success of any Brownfields site investigation that a data flow or reporting scheme be developed. For any such scheme to be effective, it must address the complete scope of measurement results generated from all facets of an environmental monitoring project including the collection of raw data through the storage of validated results. In addition, it must also completely cover the step-wise procedures for entering data onto various reporting forms, as well as, into computer systems. These procedures should always cover routine data transfer and entry validation checks to ensure these processes are complete. To assist in these efforts, whenever possible pre-printed forms should always be utilized for transcribing data.

N.1 Data Formatting

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, when conducting a Brownfields site investigation there must always be adequate documentation available to enable the summation of all pertinent measurement data. This is necessary to assist in the interpretation of the data while ensuring that it is both scientifically valid and legally defensible. As a result, it is integral that all records be legible, complete, and properly organized. In some instances, it may be appropriate to utilize a document control system. Therefore, when planning a Brownfields site investigation project, one must consider the type of record to be maintained, and the process for how these records will be stored.

N.2 Field Data Reporting

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, all real-time measurements and observations must always be recorded in project log books, field data records, or in similar types of record keeping books. Field measurements may include pH, temperature, specific conductance, alkalinity, water flow, soil gas readings, and possibly FID/PID measurements. All measurement data collected by performing in-situ analyses must always be recorded directly and legibly in field logbooks, with all entries being signed and dated. If entries must be changed, it is essential that these changes be made in such a manner that none of the original entries become obscured. Likewise, the reason for making a change should be specified with the correction and explanation being signed and dated at the time the revision was made. Therefore, to ensure the effective management of this information, it is important that field data records be organized into standard formats whenever possible, and retained in permanent files.

N.3 Laboratory Data Reporting

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, whenever laboratory data are acquired, an analytical report should always be prepared to summarize the results of each environmental sample analyzed in accordance with this generic QAPP boilerplate.

An analytical report should always contain information regarding the analytical methods or procedures employed, sample results, QA/QC results, chain of custody documentation, laboratory correspondence, and all accompanying raw data. It is integral that all data necessary for calculating percent recoveries be presented along with the analytical results.

To facilitate data interpretation efforts, it is advantageous for analytical reports to have all environmental sample data cross-referenced with the appropriate QC audit results (field blank, equipment rinsate blank, field duplicate, matrix spike, and matrix spike duplicate, etc.). Analytical reports should always cross- reference all laboratory data identification numbers with the corresponding field sample codes noted on the chain-of-custody as well. In addition, all pertinent handling/processing dates (time of collection, laboratory receipt, extraction, and analysis) for each sample applicable to the project must be referenced along with the applicable sample holding time.

Another important aspect to consider when formatting requirements for assembling an analytical report are the units for reporting final laboratory results. In most instances, the appropriate units for the reporting of final laboratory results are often dictated by factors such as the environmental sample media, analytical methodology, program/regulatory requirements, project objectives, and performance criteria. Therefore, it is important to specify the appropriate deliverables needed to assemble a complete analytical package for documenting that the pertinent resulting data are of an appropriate quality.

N.4 Data Management and Documentation Requirements

The selected contractor will manage and document the field data. Dresdner Robin will conduct field quality assurance and oversight of the contractors work. Field data will be entered into field notebooks dedicated to this project. Photocopies of separate data sheets, such as boring logs created by the contractor/driller, will be stapled into the field notebooks. Sample Chain-of-Custody copies, field notebooks and all analytical data and the QC data package reports received from the laboratory will be kept in the project files in Dresdner Robin's office.

The selected analytical laboratory will manage and document the laboratory data. This selected laboratory will have to provide the procedures that will be used to manage data in their Quality Assurance Manual, including the issues of:

- Accuracy,
- Precision,
- Data quality assessment,
- Information management,
- Sample control and management,
- Data generation,
- Verification and approval reports,
- Reduction and storage, and
- Document control.

The selected contractor's laboratory will submit a final report that will include:

- The sampling results, and
- A QC data package.

The QC package will be required to describe any issues or concerns that arose in extracting and analyzing the samples, organic surrogate recoveries, method blank results, laboratory control samples, MS/MSD results for organic analyses, and laboratory duplicate/spike sample results for inorganic analyses.

Dresdner Robin will conduct a data validation on the project data. Twenty percent of the laboratory samples, collected for Site characterization/delineation NJDEP and Site Remediation Progress. Analyzed will be subjected to full data validation. Data validation will adhere to the procedures given in the following documents:

- CLP Protocol SOP No. HW-6: CLP Organics Data Review
- Preliminary Review SOP No. HW-2: Evaluation of Metals Data for Contract Laboratory Protocol; and
- USEPA Guidance for Data Quality Assessment, Practical Methods for Data Analysis.

N.4.1 Fixed Laboratory Data Deliverable Requirements

The laboratory deliverable package will adhere to the **USEPA Contract Laboratory Program Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration OLM0 4.2** or latest revision for organics and **USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration ILM0 4.0** or latest revision for metals.

The laboratory data will be reviewed by the methods found in:

- CLP Protocol SOP No. HW-6: CLP Organics Data Review;
- Preliminary Review SOP No. HW-2: Evaluation of Metals Data for Contract Laboratory Protocol; and
- USEPA Guidance for Data Quality Assessment, Practical Methods for Data Analysis.

N.4.2 In-situ Field Analytical Data Deliverable Requirements

The analytical data deliverables for the Photoionization Detector (PID) will be entered onto the field screening data sheets. These data sheets will require entries for:

- Date and time of instrument calibration
- Deviations from the acceptance criteria and the corrective actions taken and the outcome, and
- Sampling results for every sample collected during the field effort.

O.0 Quality Assurance Requirements

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, the data collection scheme put forward in this generic Brownfields QAPP boilerplate encourages the design of a monitoring network which blends in-situ field analytical screening techniques with confirmatory fixed laboratory analyses. It specifies that a minimum of 20% of all samples collected during a Brownfields site investigation undergo fixed laboratory U.S.EPA CLP TAL and TCL confirmatory analyses. In conjunction, it specifies that approximately 50% of all background or "presumed clean" reference samples should likewise undergo fixed laboratory U.S.EPA CLP TAL and TCL confirmatory analyses to limit false negative and sampling errors. Therefore, to ensure data are of an appropriate quality, the following protocols apply whenever duplicate samples are collected to c onfirm field screening and/or laboratory analyses with limited analytical deliverables:

- When applicable, rinse and trip blanks will be collected and analyzed with all environmental samples.
- When CLP methods are used to corroborate field sampling or laboratory data with limited analytical deliverables, additional method specific duplicate samples should not be analyzed.
- Protocols for these CLP confirmatory analytical methods, sample containers, data deliverables, preservatives, chain-of-custody forms, matrix spike sample volumes, and shipping requirements are derived from the U.S.EPA Sampler's Guide to the CLP.

O.1 Definitive Data Requirements

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate **, w**hen conducting a Brownfields site investigation, definitive data should always be acquired using rigorous analytical protocols, such as conventional U.S.EPA reference methods. This involves securing the acquisition of data which are media-specific to confirm target analyte identities and concentrations. Conventional analytical methods are known to produce tangible raw data (chromatograms, spectra, digital values, etc.) in the form of paper printouts and/or computer-generated electronic files. In most instances, definitive data can be generated at the site with a field analytical screening technique or at an off-site fixed laboratory by employing the necessary QA/QC protocols. But regardless of what type of determination is utilized, for data to be definitive, an assessment of analytical or total measurement error must be determined. Therefore, the following criteria should always be implemented when performing a site- specific Brownfields investigation:

- Definitive data QA/QC elements.
- Sample documentation (location, date and time collected, batch, etc.).
- Chain of custody for samples analyzed by an off-site laboratory.
- Sampling design approach (systematic, simple or stratified random, judgmental, etc.).
- Initial and continuing calibration.
- Determination and documentation of instrument and method detection limits.
- Analyte(s) identification.
- Analyte(s) quantification.
- QC blanks (trip, method, rinsate).
- Matrix spike recoveries.

O.2 Analytical Error

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, performing an estimate of analytical error is the process of determining a m easure of overall precision for a particular analytical method. To render a determination of analytical error, an appropriate number of duplicate aliquots are taken from at least one thoroughly homogenized sample. These duplicate sample aliquots are then analyzed with standard laboratory QC parameters to calculate and compare method performance criteria (variance, mean, and coefficient of variation).

O.3 Total Measurement Error

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, the determination of total measurement error is an estimate of the overall precision of an environmental data acquisition system, from sample collection through analysis. To render a determination of total measurement error, an appropriate number of samples are independently collected from the same location. These co-located samples are then analyzed with standard laboratory QC parameters to calculate and assess measurement error goals (variance, mean, and coefficient of variation). Measurement error goals are acceptance/performance criteria typically established for the purpose of evaluating data quality. To ascertain a thorough assessment of total measurement error, this process should be undertaken for each environmental matrix under investigation and/or repeated for a given media at more than one location.

O.4 Assessment and Response Actions

The sampling personnel are the first to detect and correct problems that could or will affect field data quality. They can often detect instrument perturbations, or malfunctions and correct them. In the case of major malfunctions, they are usually the best to select and quickly implement corrective actions so that data corruption and loss is minimized. Therefore, this SAMP requires field sampling personnel to try to detect problems early. Then the field sampling personnel should consult the on-site field supervisor, who will make the ultimate choices regarding the corrective action or actions that will be taken.

If a malfunction or problem arises, the following steps will be followed:

- Define the malfunction in the context of data validity;
- Determine who should investigate the malfunction;
- The assigned person(s) will investigate the malfunction;
- The assigned person(s) and supervision will determine the appropriate corrective action;
- Determine who should implement the corrective action;
- Determine how effective the corrective action is and implement the correction;
- Check to see if the malfunction has been eliminated by the corrective action;
- Repeat the above steps until the malfunction is eliminated.

All malfunctions and problems will be documented in a separate field log to allow review during the data validation. Items that will be recorded are:

- Name of the person who identified the malfunction;
- A statement defining the malfunction;
- The corrective action prescribed;
- The schedule for completing the corrective action;
- Signatures of each responsible party, including the field supervision.

Analytical laboratory results will be assessed for compliance with the degree of precision, accuracy, completeness and sensitivity as required as follows:

Precision of laboratory analyses will be assessed by comparing the analytical results of analytical laboratory duplicate analyses. The relative percent difference (RPD) will be calculated for each pair of duplicate analyses using the formula that appears below.

Accuracy of laboratory results will be assessed for compliance with the established Quality Control criteria that are described in the companion QAPP using the analytical results of method blanks, reagent/preparation blanks, matrix spikes samples and field blanks. The percent recovery (in%) of matrix spike samples will be calculated using the formula that appears below.

Completeness will be assessed by comparing the number of valid (usable results (as determined by a QA/QC Officer – Analytical Activities) to the total possible number of results using the formula that appears below. The completeness of laboratory analyses must be 80 percent or greater. If the completeness requirement for the project is not ultimately satisfied, the valid data will remain usable.

Reaching of targeted quantitation limits depends on instrument sensitivity and matrix effects. Therefore, monitoring instrument sensitivity is important to ensure data quality through consistent instrument performance. The instrument sensitivity will be monitored by the analysis of method blanks and calibration check samples.

Standard statistical formulas will be used to evaluate data and determine precision and accuracy. The arithmetic mean is defined as the average obtained by dividing a sum by the number of its addends. A number of recovery results are averaged together to improve the accuracy of the measurement. The following equation will be used to determine the arithmetic mean.

Where n = number of measurements
X_i = value of measurements

The standard deviation is defined as the square root of the average squared difference between the individual values and the average value. A number of recovery results are evaluated to find the numerical variation in the data that is then used in the determination of the percent relative standard deviation. The following equation will be used to determine the standard deviation.

$$\delta_{n-1} = \sqrt{\frac{\sum_{i=1}^{n} (X - \overline{X})^2}{n-1}}$$

Where n = number of measurements
X_i = value of measurements arithmetic mean

The percent relative standard deviation (%RSD) is determined by dividing the standard deviation of the values by the arithmetic mean of the values and multiplying by 100. The %RSD is calculated on a series of measurements to evaluate the instrument's analytical precision (e.g., initial calibration).

The following equation will be used to determine %RSD.

$$\%RSD = (\delta_{n-1}) \times 100 / \overline{X},$$

Where δ_{n-1} = standard deviation
$\overline{X}$ = arithmetic mean

The percent recovery of a parameter will be determined by dividing the amount recovered by the true amount added and multiplying by 100. The percent recoveries of spiked samples are evaluated to establish the analytical accuracy of a measurement. The following equation will be used to determine the percent recovery.

$$\%R = (SSR - SR) \times 100 / SA$$

Where SSR = spiked sample result
SR = sample result or background
SA = spike added

The relative percent difference will be determined by dividing the difference between two numbers by their arithmetic mean and multiplying by 100. The RPD will determine the analytical precision of two duplicate measurements. The following equation will be used to determine RPD.

$$RPD = ((\mid R_1 - R_2 \mid) / ((R_1 + R_2) / 2)) \times 100$$

Where R_1 = value of the first result
R_2 = value of the second result

System or performance audits or standard QC procedures will be used to determine the need for corrective action. The necessary steps in the corrective action system will be:

1. Checking to see if predetermined limits for data acceptability have been exceeded;
2. Identifying and defining malfunctions and problems;
3. Assigning responsibility for investigating a malfunction or problem;
4. Investigating and determining the cause of the malfunction or problem;
5. Determining a corrective action to eliminate the malfunction or problem;
6. Assigning and accepting responsibility for undertaking the corrective action;
7. Undertaking the corrective action and evaluating its effectiveness;
8. Determining if the corrective action has eliminated the problem; and,
9. Documenting the corrective action and its effect.

For each measurement system, the measurement analyst will be responsible for identifying the need for corrective action and initiating the corrective action procedure. The laboratory supervisor will be responsible for the implementation of the corrective action and evaluation its effectiveness. The laboratory QA Officer will be responsible for documenting the fact that the corrective action has resolved the malfunction or problem. The corrective action implemented will depend upon the QA/QC criteria that did not meet the necessary criteria and may range from qualifying the data to re-sampling at the site. All malfunctions and problems requiring corrective action and the corrective action employed to resolve the problem will be reported. Field corrective action will consist of repeated sampling and will be documented in the field logbook. Please refer to the LQAP and ILA provided in Attachment B-1 (to be provided when laboratory is selected) for laboratory corrective action information.

O.5 Correlation of Fixed Laboratory and In-situ Field Analytical Data

The contractor will ensure that continuous samples of soil are collected from each soil boring. The soil samples will be screened with the PID at 6-inch intervals and the sample with the greatest PID reading in the headspace will be sent for laboratory analysis in accordance with the sampling plan (see **Table 2 and 3** of RAW). If no elevated readings are determined via the PID or no staining or odor is identified, then a sample at a grain size or color discontinuity will be selected for laboratory analysis. If no grain size or color discontinuity exists, then a sample will be collected at a random depth between the top and bottom.

Refer to section E.1 of the SAMP for a detailed description of sampling program design.

P.0 Quality Assurance Reporting

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, when conducting a Brownfields site investigation, it is essential to establish mechanisms for providing periodic reports on measurement system performance and data quality to management. These reports should always provide an assessment of measurement data in terms of PARCC, performance audit results, systems audit results, and significant QA problems along with any recommended solutions. In addition, it is prudent that these reports be prepared to include a separate QA section for the purpose of summarizing pertinent information on environmental measurement data quality.

P.1 Roles and Responsibilities

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, to ensure the successful outcome of any Brownfields site investigation project, it is integral for the environmental professional responsible for leading a municipality's remedial efforts to maintain close contact with the U.S.EPA Remedial Project Manager. This is necessary to ensure that pertinent information regarding the technical and financial progress of a site-specific Brownfields investigation is fully understood by all the parties which are involved. Customarily, this communication will begin upon the award of a U.S.EPA Brownfields pilot project grant. This will than necessitate the initiation of QA activities such as the development of project planning documentation.

P.2 Trip Reports

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, to provide a detailed accounting of what occurred during a particular sampling mobilization, trip reports are to be prepared for each site-specific Brownfields investigation. Traditionally, trip reports are to be completed within two weeks of the last day of each sampling mobilization. For the effective use of trip reports, it is important that they provide information in a timely manner by noting major events, dates, and personnel on-site (including affiliations). To facilitate these efforts, trip reports should be assembled as follows:

- Background.
- Observations and Activities.
- Conclusions and Recommendations (optional).
- Future Activities.

P.3 Project Report Requirements

A single Remedial Action Report will be prepared by Dresdner Robin after the completion of all field activities and all laboratory results have been validated. In this report will be:

- Details of the remedial actions conducted;
- Descriptions of all sampling activities;

- A summary and discussion of the field screening and laboratory analytical results;
- Recommendations for any further site investigation or remedial actions.

The following will be prepared by Dresdner Robin and will be included as attachments to the Site Investigation Report:

- Field logs;
- Field screening logs;
- Soil boring logs;
- Chain of custodies;
- Calibration logs;
- Complete field screening results; and,
- Complete laboratory results including electronic data deliverables, where applicable.

The Project Manager will ensure the report will be delivered to the Camden Redevelopment Agency in accordance with the approved schedule.

Q-1.0 Performance and Systems Audits

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, when conducting a Brownfields site investigation it is integral to perform internal, as well as, external performance and systems audits. These audits are undertaken to evaluate the capability and performance of the total measurement system comprising a Brownfields environmental monitoring network. These oversight activities are useful in ensuring that field activities are providing samples reflective of the site and its conditions.

To evaluate the accuracy of the total measurement system or component thereof, performance audits are usually undertaken periodically to assess data collection efforts. In regard to field sampling operations, this oversight function is performed to critique in-situ monitoring efforts and sample collection activities. However, for performance audits to be effective, they should be scheduled in accordance with the applicable field operations warranting oversight.

Alternately, a systems audit focuses on evaluating the principal components of a measurement system to determine proper selection and use. In regard to field sampling operations, this oversight activity is performed to critique the quality control procedures which are to be employed. Systems audits of this nature are to be performed periodically, prior to or shortly after, field operations commence until the project is completed.

Q-1.1 Verification of Sampling Procedures

Reviews of the sampling activities will be conducted by the Site Supervisor and/or Project Manager. The intent of these reviews will be to verify that all established procedures that are documented in the QAPP are followed. Reviews will be conducted at the beginning of site activities and at the midpoint of the field work. Each review will include an examination of proposed and actual field sampling records, field instrument operating records, sample collection frequencies and techniques, maintenance of QA procedures, and chain-of-custody documentation. The reviews will be documented in a field notebook dedicated to this purpose for easy reference during data validation. Follow-up reviews will be required to document the correction of any deficiencies and the results of such reviews will be noted in the dedicated field notebook.

Q-2.0 Data Validation

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, to ensure that the measurement data acquired when performing a Brownfields site investigation are of an appropriate quality, it is important to specify and follow procedures for validating all pertinent environmental monitoring results. Data validation is regarded as a systematic process for reviewing a body of results against a set of established criteria to provide a specified level of assurance concerning validity. It requires a systematic and uniform evaluation to be performed on the data to identify those results with questionable quantitative value.

The approach for performing data validation should always be independent of the data production effort, and objective in its application. In most instances, the criteria for validating data will include conducting checks for internal consistency, reviews for transmittal errors, and/or audits for verifying laboratory capability. This will typically involve interpreting the results of external performance audits such as split sample, duplicate sample (field and laboratory), spiked sample, and initial calibration determinations. In conjunction, the assessment of detection limit studies, intra-laboratory comparisons, inter-laboratory comparisons, tests for normality, tests for outliers, and data base entry checks may also be undertaken.

Q-2.1 Data Verification and Validation Requirements

Field screening and laboratory data will be reviewed to verify conformance with this plan's requirements for data quality. The QA/QC results will be reviewed to verify that the duplicate samples, trip blanks, equipment blanks, and matrix spike/matrix spike duplicates met the acceptance criteria listed in Form M. Failure to meet these requirements will result in uncertainties in data usability (see Form R). Additional steps to verify data quality will be:

- The complete laboratory data package, as provided by the contractor, will be reviewed for completeness, correctness and contractual compliance. The following will be ensured:
  - All samples will be accounted for;
  - The required analyses were performed for each sample;
  - QA/QC sample results are provided; and,
  - Data transcription is free of errors.

- The QC package received from the laboratory will be reviewed to verify that it includes all of the elements listed in Form N (narrative description of any issues or problems encountered in extracting and analyzing the samples, organic surrogate recoveries, laboratory control sample recoveries, method blank results, MS/MSD results for organic analyses, and laboratory duplicate/spike sample results for inorganic analyses). Should any of these elements be missing from the QC data package, Dresdner Robin will request the information from the selected laboratory. A complete copy of the laboratory results and QC data package will be included in the final Phase II ESA report as an attachment. The QA/QC review, including the results of data verification and validation, will be discussed in the final report.

The conclusions and recommendations made in the report will be qualified to the degree that uncertainties about the validity of the sampling results are determined.

Additionally, the data will be reviewed to determine if the requirements of the site investigation have been met, including:

- Assess soil quality in each area of concern to determine if, and where, there are any exceedances of the NJDEP Soil Remediation Standards.
- Determine if the levels of contaminants in soil are sufficient that, in light of the planned redevelopment activities, certain recommendations for remedial activities must be made.

To ensure that the data meet the needs of the SAMP and the site assessment, the following steps will be followed:

- Dresdner Robin will perform the data validation for the SAMP. Data validation will follow the procedures outlined in the CLP Protocol SOP No. HW-6: CLP Organics Data Review and Preliminary Review, SOP No. HW-2: Evaluation of Metals Data for Contract Laboratory Protocol, and the USEPA Guidance for Data Quality Assessment, Practical Methods for Data Analysis.
- Review the corrective action log and the sampling review log to assess whether there were significant anomalies or problems with the data collection.
- Tabulate all field screening and laboratory data on site map to verify that the results are consistent and reasonable based on knowledge of past site activities.
- Verify that a minimum of 90 percent of the laboratory analyzed samples were validated and deemed acceptable by the laboratory.
- Verify that the QA/QC criteria for the duplicate samples and blanks were met.

Q-2.1.1 Fixed Laboratory Confirmatory Data Verification and Validation Requirements

Dresdner Robin will perform the data validation for the SAMP. Data validation will follow the procedures outlined in the CLP Protocol SOP No. HW-6: CLP Organics Data Review and Preliminary Review, SOP No. HW-2: Evaluation of Metals Data for Contract Laboratory Protocol, and USEPA Guidance for Data Quality Assessment, Practical Methods for Data Analysis. Full data validation will be performed on 20 percent of the laboratory samples.

The laboratory deliverable package will conform to the USEPA – Contract Laboratory Protocol OLMO 4.2 for organic analytes and the USEPA – Contract Laboratory Protocol ILMO 4.1 for the inorganic analytes.

Q-2.1.2 In-situ Field Analytical Data Verification and Validation Requirements

Data verification and validation of the in-situ field analytical equipment will be performed in the following manner:

- All field logs will be reviewed for accuracy and unusual conditions.
- The corrective action log and the sampling review log will be reviewed to assess whether there were significant anomalies or problems with the data collection.
- All field screening data will be depicted on a site map to verify that the results are consistent and reasonable based on the known information about past site activities.
- The field data will be reviewed to verify that it is consistent with the laboratory data via the relative percent difference method.

R.0 Data Quality Assessment

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate, when performing a Brownfields site investigation, it is essential to correlate validated measurement data for reconciliation with the acceptance/performance criteria specified for the project. T his will involve rendering a determination to ascertain whether measurement data are of the right type, quality, and quantity required to support environmental decision making efforts. To perform this activity, scientific and statistical procedures must be employed to provide an assessment.

The technique for determining if validated measurement results are adequate for their intended use is known as the Data Quality Assessment (DQA) process. The DQA process can provide information to enable a decision maker to draw conclusions about the strength of evidence depicted by a set of collected measurement data. To assist in these efforts, an outline of the formal DQA process is described in the U.S.EPA Guidance for Data Quality Assessment: Practical Methods for Data Analysis. As previously noted, this guide is included as an attachment to this generic QAPP boilerplate.

R.1 Data Quality Assessment Process

As per the U.S.EPA Region 2 generic Brownfields QAPP boilerplate The DQA process is both a scientific and statistical evaluation technique which consists of the following five steps:

- Review project acceptance/performance criteria and sampling design.
- Conduct a preliminary data review.
- Select a statistical test (i.e., Shaprio-Wilk W test, Student's t-Test, etc.).
- Verify the assumptions of the selected statistical test.
- Draw conclusions from the data.

Even if the formal DQA process is not followed in its entirety, a systematic assessment of measurement data quality should always be performed when conducting a Brownfields site investigation. This systematic process will involve carrying out the following data assessments:

- Validating all pertinent measurement data for scientific anomalies.
- Correlating all pertinent measurement data to the PARCC parameters designated for the project.
- Identifying measurement data trends and outliers.

In doing so, one can assimilate an abstract estimation of data "worth" to provide Brownfields stakeholders with a rationale for making proper decisions.

R.2 Data Usability/Reconciliation Requirements

All of the field screening results and laboratory data will be included in the final Remedial Action Report. Any questions on the usability of the data that come to light in the data review will be described in the report. The conclusions and recommendations made in the report will be qualified if there are uncertainties about the validity of the sampling results. All fixed laboratory data will be compared to the NJDEP Soil Remediation Standards. The report will include a discussion of the usability of the field and fixed laboratory data based upon the data validation/usability evaluation described above.

ATTACHMENTS

ATTACHMENT A

MiniRAE 2000 Portable VOC Monitor,

Operation and Maintenance Manual,

Rev. May 2005, PGM-7600

MiniRAE 2000

Portable VOC Monitor
PGM-7600

OPERATION AND MAINTENANCE MANUAL

(Document No.: 011-4001-000)
Revision E, May 2005

RAE SYSTEMS

ISO 9001 CERTIFIED

4. PROGRAMMING OF MINIRAE 2000

The MiniRAE 2000 Monitor is built with a microcomputer to provide programming flexibility. Authorized users can re-calibrate the monitor, change the alarm limits, change site ID, user ID, lamp type, and real time clock, etc.

Programming is menu-driven to provide intuitive end-user operation. The display shows the menu options and the key pad used for menu selection and data entry.

4.1 Programming Mode

The programming mode allows the users to change the setups in the monitor, calibrate the monitor, modify the sensor configuration and enter user information, etc. The programming mode has four menu items. Each menu item includes several sub-menus to perform additional programming functions. Appendix A shows a more detailed menu tree structure.

Programming Menu

Calibrate/Select Gas?

Change Alarm Limits?

Change Datalog?

Change Monitor Setup?

Once inside the programming mode, the LCD will display the first menu. Each subsequent menu item can be viewed by pressing the **[N/-]** repeatedly until the desired menu is displayed. To enter the sub-menu of a particular menu, press **[Y/+]** key, the sub-menu will be displayed.

Return to Operation mode: To exit the programming mode and return to operation, press the **[MODE]** key once at any of the programming menu displays.

4.2 Keys for Programming Mode

The three keys perform a different set of functions during the programming mode as summarized below.

Key	Function in Programming Mode
[MODE]:	Exit menu when pressed momentarily or exit data entry mode when pressed and held for 1 second
[Y/+]:	Increase alphanumerical value for data entry or confirm (yes) for a question
[N/-]:	Decrease alphanumerical value for data entry or deny (no) for a question

4.3 Entering into Programming Mode

1. Turn on the MiniRAE 2000 monitor and wait for the **"Ready.."** message or the instantaneous reading display **"0.0 ppm"** message displayed.
2. Press and hold down both **[N/-]** and **[MODE]** keys for three seconds to enter programming mode. This delay is to prevent the user from entering programming mode by accident.
3. The first menu item "Calibrate/select Gas?" will be displayed.
4. Release both **[MODE]** and **[N/-]** keys simultaneously to start the programming mode
5. Press **[N/-]** key to scroll to the next menu item of the programming menu. Press **[Y/+]** key to select the displayed menu item.

The following Sections 4.4 - 4.7 describe the details of each menu options.

4.4 Calibrate and Select Gas

WARNINGS

The calibration of all newly purchased RAE Systems instruments should be tested by exposing the sensor(s) to known concentration calibration gas before the instrument is put into service for the first time.

For maximum safety, the accuracy of the MiniRAE 2000 should be checked by exposing it to known concentration calibration gas before each day's use.

In the first menu of the programming mode, the user can perform functions such as calibration of the MiniRAE 2000 Monitor, select default cal memories, and modify cal memories (see Table 4.4).

Table 4.4

Calibrate/Select Gas Sub-Menu
Fresh Air Cal?
Span Cal?
Select Cal Memory?
Change Span Value?
Modify Cal Memory?
Change Correction Factor?

Calibrating the MiniRAE 2000 monitor is a two-point process using "fresh air " and the standard reference gas (also known as span gas). First a "Fresh air" calibration, which contains no detectable VOC (0.0 ppm), is used to set the zero point for the sensor. Then a standard reference gas that contains a known concentration of a given gas is used to set the second point of reference.

Note: The span value must be set prior to calibrating for fresh air or span.

The user can store calibrations for up to 8 different measurement gases. The default gas selections are as follows:

Cal Memory #0......Isobutylene

Cal Memory #1......Hexane

Cal Memory #2......Xylene

Cal Memory #3......Benzene

Cal Memory #4......Styrene

Cal Memory #5......Toluene

Cal Memory #6......Vinyl Chloride

Cal Memory #7......Custom?

Memory #0 functions differently than the other 7 memories. For Memory #0, isobutylene is always the calibration gas. When the gas is changed in Memory #0 to one of 100 other preprogrammed chemicals or to a user-defined custom gas, a correction factor is applied to all the readings. During calibration, the unit requests isobutylene gas and displays the isobutylene concentration immediately following calibration, but when the unit is returned to the normal reading mode, it displays the selected gas and applies the correction factor.

The other 7 cal memories require the same calibration gas as the measurement gas. These memories may also be modified to a preprogrammed chemical or to a user-defined custom gas. In the gas library, only the gases that can be detected by the installed UV lamp will actually be displayed. Note that although the correction factor for the new gas will be displayed and can be modified, this factor is not applied when Memories #1-7 are used. Therefore the factor will not affect the readings in these memories.

Once each of the memories has been calibrated, the user can switch between the calibrated gases by changing the cal memory without the need to recalibrate. Or the user can switch the measurement gas in Memory #0 and the appropriate correction factor will automatically be applied without the need to recalibrate. If the gas is changed in Memories #1-7, it is necessary to recalibrate.

To change a default gas from the list above to a library or custom gas, first go to Select Cal Memory (Section 4.4.3) and then proceed to Modify Cal Memory (Section 4.4.5) to enter the desired gas. If the desired compound does not appear in the preprogrammed library, the user can use the Custom_VOC entry in the library, or the name and correction factor of any of the existing compounds can be changed as described in Section 4.4.5. A list of some 300 correction factors is given in Technical Note 106, available at the website www.raesystems.com.

4.4.1 Fresh Air Calibration

This procedure determines the zero point of the sensor calibration curve. To perform a fresh air calibration, use the calibration adapter to connect the MiniRAE 2000 to a "fresh" air source such as from a cylinder or Tedlar bag (option accessory). The "fresh" air is clean dry air without any organic impurities. If such an air cylinder is not available, any clean ambient air without detectable contaminant or a charcoal filter can be used.

1. The first sub-menu shows: "Fresh air Cal?"
2. Make sure that the MiniRAE 2000 is connected to one of the "fresh" air sources described above.
3. Press the **[Y/+]** key, the display shows "zero in progress" followed by "wait.." and a countdown timer.

After about 15 seconds pause, the display will show the message "update data...zeroed... reading = X.X ppm..." Press any key or wait about 20 seconds, the monitor will return back to "Fresh air Calibration?" submenu.

4.4.2 Span Calibration

This procedure determines the second point of the sensor calibration curve for the sensor. A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure. Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar Bag, or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the MiniRAE 2000 Monitor, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

Before executing a span calibration, make sure the span value has been set correctly (see next sub-menu).

1. Make sure the monitor is connected to one of the span gas sources described above.
2. Press the **[Y/+]** key at the "Span Cal?" to start the calibration. The display shows the gas name and the span value of the corresponding gas.
3. The display shows "Apply gas now!" Turn on the valve of the span gas supply.

4. Display shows "wait.... 30" with a count down timer showing the number of remaining seconds while the monitor performs the calibration.

5. To abort the calibration, press any key during the count down. The display shows "Aborted!" and return to "Span Cal?" sub-menu.

6. When the count down timer reaches 0, the display shows the calibrated value.

   Note: The reading should be very close to the span gas value.

7. During calibration, the monitor waits for an increased signal before starting the countdown timer. If a minimal response is not obtained after 35 seconds, the monitor displays "No Gas!" Check the span gas valve is on and for lamp or sensor failure before trying again.

8. The calibration can be started manually by pressing any key while the "Apply gas now!" is displayed.

9. After a span calibration is completed, the display will show the message "Update Data Span Cal Done! Turn Off Gas."

10. Turn off the flow of gas. Disconnect the calibration adapter or Tedlar bag from the MiniRAE 2000 Monitor.

11. Press any key and it returns back to "Span Gas Cal?"

4.4.3 Select Cal Memory

This function allows the user to select one of eight different memories for gas calibration and measurement. For Memories #1-7, the calibration and measurement gas is the same and no correction factor is applied. For Memory #0, the calibration gas is always isobutylene and the measurement gas may be different, in which case the correction factor for that gas is automatically applied. The default gas selections are listed in Section 4.4

1. "Select Cal Memory?" is the third sub-menu item in the Calibration sub-menu. Pressing the **[Y/+]** key, the display will show "Gas =" gas name followed by "Mem # x?"
2. Press **[N/-]** to scroll through all the memory numbers and the gas selections respectively. Press **[Y/+]** to accept the displayed Cal Memory number.
3. After the **[Y/+]** key is pressed, the display shows "Save?" Press **[Y/+]** key to save and proceed. Press **[N/-]** to discard the entry and advance to the next sub-menu.
4. If the gas in a newly selected Cal Memory number is not calibrated, the display shows "CF= x.xx". A correction factor with the value "x.xx" will be applied.
5. If the gas of a newly selected cal memory number has been calibrated previously, the display shows "Last calibrated xx/xx/xx".

4.4.4 Change Span Value

This function allows the user to change the span values of the calibration gases.

1. "Change Span Value?" is the fourth sub-menu item in the Calibration sub-menu
2. Press **[Y/+]**, display shows the gas name and the span value. A cursor will blink at the first digit of the Span value. To modify the span gas value, go to Step 3. Otherwise, press and hold the **[MODE]** key for 1 second to accept the previously stored span gas value and move to the next sub-menu.
3. Starting from the left-most digit of the span gas value, use the **[Y/+]** or **[N/-]** key to change the digit value and press **[MODE]** key momentarily to advance to next digit. Repeat this process until all digits are entered. Press and hold the **[MODE]** for 1 second to exit.
4. The display shows "Save?" To accept the new value, press the **[Y/+]** key. Press the **[N/-]** key or the **[MODE]** key to discard the change and move to the next sub-menu.

4.4.5 Modify Cal Memory

If the current cal memory number selected is not memory 0, users will be prompted whether to modify the settings of the selected cal memory. Press **[Y/+]** to modify the cal memory and **[N/-]** to go to the next sub-menu.

Once **[Y/+]** is pressed the LCD display will show the current memory number, current Gas selected and prompt user for acceptance of current gas selected.

1. Press **[N/-]** to modify the gas selection if desired. Or press **[Y/+]** key to skip the change of gas selection, and proceed to the next sub-menu.
2. After pressing **[N/-]**, display shows "Copy gas from library?" Press **[Y/+]** to accept or **[N/-]** for the next sub-menu, "Enter Custom gas?"
3. In the "Copy gas from library" submenu, use **[Y/+]** and **[N/-]** keys to scroll through the selections in the library. Press **[MODE]** key momentarily to select the gas. The display shows "Save?" Press **[Y/+]** to save or **[N/-]** to discard the changes and proceed to next sub-menu.
4. In the Custom gas sub-menu, the user can enter the gas name. Press the **[Y/+]** or **[N/-]** key to cycle through all 26 letters and 10 numerals. Press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move to the next digit to the right. Repeat this process until all digits (up to 8 digits) of the custom gas name is entered.

Press and hold the **[MODE]** key for 1 second to exit the name entry mode. The display will show "Save?" Press **[Y/+]** to save the entry, or **[N/-]** to discard the changes.

4.4.6 Change Correction Factor

This function allows the user to change the Correction Factor of the standard calibration gas (only for Cal Memory #0).

1. "Change Correction Factor?" is the sixth sub-menu in the Calibration sub-menu.
2. Press **[Y/+]** key. Display shows the gas name, then the correction factor.

   A cursor blinks at the left-most digit of the correction factor. If user wants to modify the correction factor, go to Step 3. Otherwise, press and hold the **[MODE]** key for 1 second to accept the previously stored correction factor value and return to the first sub-menu of the calibrate/select gas menu.
3. Starting from the left-most digit of the correction factor, use **[Y/+]** or **[N/-]** key to change the digit value and press **[MODE]** key momentarily to advance to the next digit, the cursor will move to the next digit to the right. Repeat this process until all digits are entered. Press and hold the **[MODE]** for 1 second to exit.
4. The display shows "Save?" To confirm the new value, press **[Y/+]** to accept the change. Press **[N/-]** or **[MODE]** to discard the change and return to the first sub-menu, Calibrate and Select Gas.

4.5 Change Alarm Limits

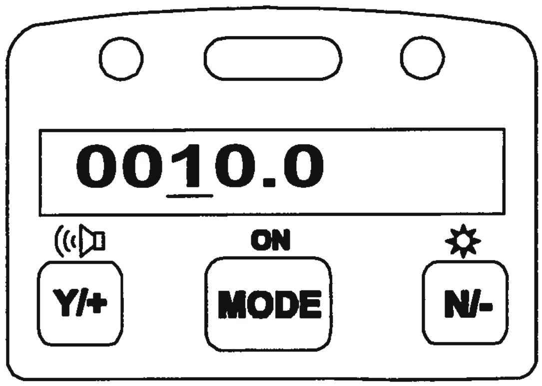
In this menu, the user can change the high and low alarm limits, the STEL limit and the TWA limit (see Table 4.5 below). Press the **[Y/+]** key and the display shows the current gas selected followed by the first sub-menu item below.

Table 4.5

Alarm Limit Sub-Menu
Change High Alarm limit?
Change Low Alarm limit?
Change STEL limit?
Change TWA limit?

1. Scroll through the Alarm Limit sub-menu using the **[N/-]** key until the display shows the desired limit to be changed, e.g.,"High limit?", "STEL limit?", etc.

2. Press the **[Y/+]** key to select the desired limit and the display shows a flashing cursor on the left-most digit of the previously stored alarm limit.



3. To modify this limit value, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move to the next digit to its right. Repeat this process until the new limit value is entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode.

4. If there is any change to the existing value, the display shows "Save?" Press **[Y/+]** to accept the new value and move to the next sub-menu. Press **[N/-]** to discard the changes and move to the next sub-menu.

4.5.1 Change Low Alarm Limit

The second sub-menu item in the Alarm Limit sub-menu allows the user to change the Low Alarm limit. The LCD displays "Low limit?" To change Low Alarm limit, press **[Y/+]** key, or Press **[N/-]** key advance to next sub-menu in Table 4.5.

1. Press **[Y/+]** and the display will show a flashing cursor on the left-most digit of the previously stored Low alarm limit.
2. To modify this limit value, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move to the next digit to its right. Repeat this process until the new limit values is entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode.
3. If there is any change to the existing value, the display shows "Save?" Press **[Y/+]** to accept the new value and move to the next sub-menu. Press **[N/-]** to discard the changes and move to the next sub-menu.

4.5.2 Change STEL Limit

This sub-menu item allows the user to change the STEL limit. The display shows "STEL limit?"

1. Press the **[Y/+]** key and the display will show a flashing cursor on the left-most digit of the previously stored STEL limit.
2. To modify this limit value, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until the new limit values is entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode.
3. If there is any change to the existing value, the display shows "Save?" Press **[Y/+]** to accept the new value and move to the next sub-menu. Press **[N/-]** to discard the changes and move to the next sub-menu.

4.5.3 Change TWA Limit

This sub-menu item allows the user to change the TWA limit. The LCD displays "TWA limit?"

1. Press **[Y/+]** and the display will show a flashing cursor on the left-most digit of the previously stored TWA limit.
2. To modify this limit value, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until the new limit values is entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode.
3. If there is any change to the existing value, the display shows "Save?" Press **[Y/+]** to accept the new value and move to the next sub-menu. Press **[N/-]** to discard the changes and move to the next sub-menu.

4.6 Change Datalog

The MiniRAE 2000 monitor calculates and stores the concentration and ID of each sample taken. In the datalog sub-menu, a user can perform the tasks and functions shown below.

Datalog Sub-Menu

Reset Peak/Minimum?

Clear Data?

Change Data Period?

Change Average Type?

4.6.1 Reset Peak

This function will reset the peak and minimum stored in the data memory. Note: this function will not clear the STEL or TWA data.

1. "Reset Peak?" is the first sub-menu item in the Datalog sub-menu (Table 4.6).
2. Press the **[Y/+]** key to reset the Peak/Minimum Values. The display shows "Are You Sure?"
3. Pressing the **[Y/+]** key again will reset the values. The display shows "Peak/Minimum Cleared" and moves to the next submenu.
4. Press the **[N/-]** or **[MODE]** key to exit without resetting the values and move to the next sub-menu.

4.6.2 Clear Data

This function will erase all data stored in the non-volatile datalog memory. Note: This function does not change STEL, TWA, Peak, Minimum and run time values, which are stored in the regular data memory.

1. "Clear Data?" is the third sub-menu item in the Datalog sub-menu.
2. Press the **[Y/+]** key to clear the datalog memory. The display shows "Are you sure?"
3. Press the **[Y/+]** key again to confirm erasure of all the datalog memory.
4. Press the **[N/-]** or **[MODE]** key to exit without clearing the datalog memory and move to the next datalog sub-menu.

4.6.3 Change Data Period

The datalog period can be programmed from 1 to 3,600 seconds (1 hour).

1. "Change Data Period?" is the fifth sub-menu item in the Datalog sub-menu.
2. Press the **[Y/+]** key and the display shows "Datalog Period = XXXX" with the left-most digit flashing, where "XXXX" is the previously stored data log period.
4. To modify this period, starting from the left-most digit, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move to the next digit to the right. Repeat this process until all 4 digits of the new period are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode.
5. If there is any change to the existing value, the display will show "Save?" Press **[Y/+]** to accept the new value or **[N/-]** to discard the changes and move to the next sub-menu.

4.6.4 Change Average Type

The user can select either an 8-hour Time Weighted Average (TWA) or a running Average. The running average is simply the average of all instantaneous (1-second) readings since the measurement was started. This average may increase or decrease with time depending on the readings. The TWA is a cumulative value used to estimate the fraction of the 8-hour limit to which the user has been exposed since the start of the measurement. This value can only increase or remain constant, never decrease. Refer to Technical Note 119 for more information on how TWA is calculated.

1. "Change Average Type?" is the sixth sub-menu in the Datalog sub-menu.
2. Press the **[Y/+]** key to enter the function.
3. The display will show "Running Average?" or " Time Weighted Average?" depending on the current average type.
4. Press **[N/-]** key to toggle between the average types. Press **[Y/+]** key to select the displayed average type.
5. If there is any change to the existing setting, the display shows "Save?" Press **[Y/+]** to save the change. Press **[N/-]** or **[MODE]** to discard the change and return to the first sub-menu.

4.7 Change Monitor Setup

Several monitor specific variables can be changed in this menu. The following is a list of configuration data that can be modified by the user.

Monitor Setup Sub-Menu	**Diagnostic Mode**
Change Operation Mode?	"
Change Site ID?	Change Unit ID?
Change User ID?	Change Host ID?
Change Alarm Mode?	"
Change User Mode?	"
Change Date?	"
Change Time?	"
Change Lamp?	"
Change Pump Duty Cycle?	"
Change Unit?	"
Change Dilution Ratio?	"
Change Output?	"
Change DAC Range?	"
Set Temperature Unit?	"

4.7.1 Change Operation Mode

MiniRAE 2000 supports two operation modes: Survey and Hygiene mode.

Survey mode: Manual start/stop of measurements and display of certain exposure values.

Hygiene mode: Automatic measurements, running and datalogging continuously and calculates additional exposure values.

1. "Change Op Mode?" is the first sub-menu item in the Monitor Setup menu (Table 4.7).
2. Press the **[Y/+]** key and the display shows the current user mode: "Op Mode = *current mode*?"
3. Press the **[Y/+]** key to accept the currently displayed operation (Op) mode. Press **[N/-]** to toggle to the other operation mode. Press **[MODE]** to exit this sub-menu and move to the next monitor setup sub-menu.
4. When changing Op mode from Hygiene to Survey, the display shows the additional message "Warning! Exit Hygiene?" to prevent accidental exit from Hygiene mode. Press the **[Y/+]** key to acknowledge.
5. If there is any change to the existing setting, the display will show "Save?" Press the **[Y/+]** key to accept or the **[N/-]** key to discard and move to the next sub-menu.

Note: If a new Op Mode is saved, the display shows "Op Mode changed!!" when exiting the programming mode.

4.7.2 Change Site ID

The user can enter an 8-digit alphanumeric site ID in the programming mode. This site ID will be included in the datalog report.

1. "Change Site ID?" is the second sub-menu item in the Monitor Setup menu (Table 4.7).
2. Press the **[Y/+]** key and the display shows the current site ID: "Site ID = xxxxxxx" with the left most digit flashing.
3. Press the **[Y/+]** or **[N/-]** key to cycle through all 26 letters and 10 numerals. Press **[MODE]** momentarily to advance to the next digit. The flashing digit will move to the next digit to the right. Repeat this process until all 8 digits of the new site ID are entered.
4. Press and hold the **[MODE]** key for 1 second to exit the data entry mode.
5. If there is any change to the existing site ID, the display shows "Save?" Press the **[Y/+]** key to accept the new site ID. Press the **[N/-]** key to discard the change and move to the next sub-menu.

4.7.3 Change User ID

The user can enter an 8-digit alphanumeric user ID in the programming mode. This user ID will be included in the datalog report.

1. "Change User ID?" is the third sub-menu item the Monitor Setup menu.
2. Press the **[Y/+]** key and the display shows the current user ID: "User ID = xxxxxxxx" with the left most digit flashing.
3. Press the **[Y/+]** or **[N/-]** key to cycle through all 26 letters and 10 numerals. Press **[MODE]** momentarily to advance to the next digit. The flashing digit will move to the next digit to the right. Repeat this process until all 8 digits of the new user ID are entered.
4. Press and hold the **[MODE]** key for 1 second to exit the data entry mode.
5. If there is any change to the existing user ID, the display shows "Save?" Press the **[Y/+]** key to accept the new user ID. Or press the **[N/-]** key to discard the changes and move to the next sub-menu.

4.7.4 Change Alarm Mode?

There are two different alarm modes: **Latched** and **Automatic Reset** (Auto Reset) in the MiniRAE 2000 that can be selected from the programming menu.

1. "Change Alarm Mode?" is the fourth sub-menu item in the Monitor Setup menu.
2. Press the **[Y/+]** key; the display shows the current alarm mode.
3. Press the **[Y/+]** key to accept the currently displayed alarm mode. Press **[N/-]** key to toggle to the other alarm mode. Press **[MODE]** to exit this sub-menu and move to the next monitor setup sub-menu.
4. If there is any change to the existing setting, the display will show "Save?" Press **[Y/+]** to save the change. Press **[N/-]** or **[MODE]** to discard the change and move to the next sub-menu.

4.7.5 Change User Mode

There are two different user modes: **Display** and **Program** that can be selected from the programming menu.

1. "Change User Mode?" is the fifth sub-menu item in the Monitor Setup menu (Table 4.7).
2. Press the **[Y/+]** key; the display shows the current user mode selected.
3. Press the **[Y/+]** key to accept the currently displayed user mode. Press **[N/-]** key to toggle to the alternate user modes. Press **[MODE]** to exit this sub-menu and move to the next monitor setup sub-menu.
4. If there is any change to the existing selection, the display shows messages "Program change" and "Are you sure?" Press **[Y/+]** to confirm the change or press **[N/-]** or **[MODE]** to discard the changes and move to the next sub-menu.

CAUTION: If the user mode is changed to **Display** mode, the user can no longer enter the programming mode. Therefore, the user can not change the user mode back to **Program** mode in normal mode.

To restore the user mode back to **Program** mode, turn the unit off and back on in Diagnostic Mode. Next enter Program mode by holding the **[MODE] and [N/-]** keys for three seconds. Enter the password at the prompt (the default is 0000). Once program mode is entered, go to the "Change Monitor Setup" / "Change User Mode" and change the mode back to **Program.**

An alternative way to change Display mode back to Program mode is through the PC and the ProRAE-Suite software.

4.7.6 Change Date

The MiniRAE 2000 monitor is equipped with a real time clock (RTC). The user can enter the correct date and time (see 4.7.7) for the real time clock.

1. "Change Date?" is the sixth sub-menu item in the Monitor Setup menu.
2. Press **[Y/+]** and the display shows the current date "mm / dd / yy" with the left most digit of the date flashing.
5. To modify this value, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until the new date and time values are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode.
4. If there is any change to the existing value, the display shows "Save?" Press **[Y/+]** to confirm the new value or press **[N/-]** or **[MODE]** to discard the changes and move to the next sub-menu.

4.7.7 Change Time

To change the time in the RTC of the MiniRAE 2000:

1. "Change Time?" is the seventh sub-menu item in the Monitor Setup menu.
2. Press **[Y/+]** and the display shows the current time in the 24-hour format "hh : mm" with the left most digit of the time flashing.
3. To modify this value, use the **[Y/+]** or **[N/-]** key to change the digit value and press the **[MODE]** key momentarily to advance to the next digit. The flashing digit will move on to next digit to its right. Repeat this process until the new date and time values are entered. Press and hold the **[MODE]** key for 1 second to exit data entry mode.
4. If there is any change to the existing value, the display shows "Save?" Press **[Y/+]** to confirm the new value or press **[N/-]** or **[MODE]** to discard the changes and move to the next sub-menu.

4.7.8 Change Lamp

There are three UV lamps with different photon energies available for the PID sensor: **9.8 eV, 10.6 eV** and **11.7 eV**. The user can select any one of the lamps from the programming mode.

1. "Change Lamp Type?" is the eighth sub-menu item in the Monitor Setup menu (Table 4.7).
2. Press the **[Y/+]** key; the display shows the current PID lamp selection.
3. Press the **[Y/+]** key to accept the currently displayed lamp. Press **[N/-]** key to scroll through the sub-menu for other lamp selections. Press **[MODE]** to exit this sub-menu and return to the next sub-menu in Table 4.7.
4. If there is any change to the existing selection, the display will show "Save?" Press **[Y/+]** to save the new selection or press **[N/-]** or **[MODE]** to discard the change and return to the next sub-menu in Table 4.7.

4.7.9 Change Unit

User can change the display and datalog unit from parts per million (ppm) to milli-gram per cubic meter (mg/m^3).

1. "Change Unit?" is the ninth sub-menu item in the Monitor Setup sub-menu.
2. Press the **[Y/+]** key, the display should show the current unit "Display Unit = ppm?" or "Display Unit = mg?"
3. Press **[Y/+]** key to accept the currently displayed unit. Press **[N/-]** key to toggle to the other unit. Press **[MODE]** key to exit this sub-menu.
4. If there is any change to the existing selection, press **[Y/+]** to confirm the new selection or press **[N/-]** or **[MODE]** to discard the changes and move to the next sub-menu.

Caution:

1. **The correction factor in the gas library is calculated based on "ppm" unit. If "mg" unit is selected, the built-in correction factor library is not valid.**
2. **No automatic conversion between "ppm" and "mg/m^3" reading is performed by the monitor.**
3. **When the unit name is changed from "ppm" to "mg", the unit must be recalibrated with the span gas concentration entered in mg/m^3. The converse rule applies when the unit is changed from "mg" to "ppm".**

4.7.10 Change Dilution Ratio

If a dilution system is used upstream of the MiniRAE 2000 inlet port, the user can enter the dilution ratio (from 1 to 10) to compensate the readings. The unit will then display the actual concentration of the gas before dilution. The dilution ratio should be 1 in normal operation where no dilution gas is applied to the sample gas. Dilution improves accuracy and linearity when the concentrations are above a few thousand ppm.

1. "Change Dilution Ratio?" is the tenth sub-menu item in the Monitor Setup menu.
2. Press the **[Y/+]** key; the display shows the current dilution ratio: "Dilution Ratio = xx" with the left most digit flashing.
3. Press the **[Y/+]** or **[N/-]** key to increase or decrease the value of the digit. Press **[MODE]** momentarily to advance to the next digit. The flashing digit will move to the next digit to the right. Repeat this process until both digits of the new dilution ratio are entered.
4. Press and hold the **[MODE]** key for 1 second to exit the data entry mode and move to the next sub-menu.
5. If there is any change to the existing dilution ratio, the display shows "Save?" Press **[Y/+]** to confirm the new value or press **[N/-]** or **[MODE]** to discard the changes and move to the next sub-menu.

4.7.11 Change Output?

There are two different external output options: DAC (Analog output) and Alarm in the MiniRAE 2000 that can be selected from the programming menu. The alarm output can be used to connect to the optional vibration alarm (vibrator) only. The analog output, which is proportional to the gas concentration, can be connected a chart recorder or can be queried by a computer to download data in real time (see Technical Note 141).

1. "Change External Output?" is the eleventh sub-menu item in the Monitor Setup menu.
2. Press the **[Y/+]** key and the display shows the current output option selection: "Output = DAC?"
3. Press the **[Y/+]** key to accept the currently displayed output option. Press **[N/-]** to change to the other external option: "Output = Alarm?" Press **[MODE]** to exit this sub-menu and move to the next monitor setup sub-menu.
4. If there is any change to the existing selection the display will show "Save?" Then, press **[Y/+]** to save the change, press **[N/-]** to go back to Step 2, or press **[MODE]** to exit this sub-menu and move to the next monitor setup sub-menu.

4.7.12 Change DAC Range?

There are four different DAC (Digital-to-Analog Conversion) range values available in the **MiniRAE 2000: 20, 200, 2000** and **10K ppm**. The maximum 2.5V DC analog signal output from the unit will represent the range value chosen. (See for analog signal output connection.)

1. "Change DAC Range?" is the twelfth sub-menu item in the Monitor Setup menu.
2. Press the **[Y/+]** key, the display shows the current DAC Range value: "DAC Range = 2000 ppm?"
3. Press the **[Y/+]** key to accept the currently displayed value. Press **[N/-]** to scroll through the sub-menu for other range values. Press **[MODE]** to exit this sub-menu and return to the first sub-menu in Table 4.7.
4. If there is any change to the existing selection, press the **[Y/+]** key and the display will show "Save?" Press the **[Y/+]** key to save the change or press the **[N/-]** key to discard and return to the first sub-menu in Table 4.7.

4.7.13 Set Temperature Unit?

The temperature display can be switched between Fahrenheit and Celsius units.

1. “Set Temperature Unit?” is the thirteenth sub-menu item in the Monitor Setup menu.
2. Press the **[Y/+]** key, and the display shows the current setting: “Temperature Unit = Fahrenheit?”
3. Press the **[Y/+]** key to accept the currently displayed value. Press **[N/-]** to select the sub-menu “Temperature Unit = Celsius?” Press **[MODE]** to exit this sub-menu and return to the first sub-menu in Table 4.7.
4. If there is any change to the existing selection, press the **[Y/+]** key and the display will show “Save?” Press the **[Y/+]** key to save the change and return to the first sub-menu in Table 4.7 or press the **[N/-]** key to discard and return to Step 3..

4.8 Exit Programming Mode

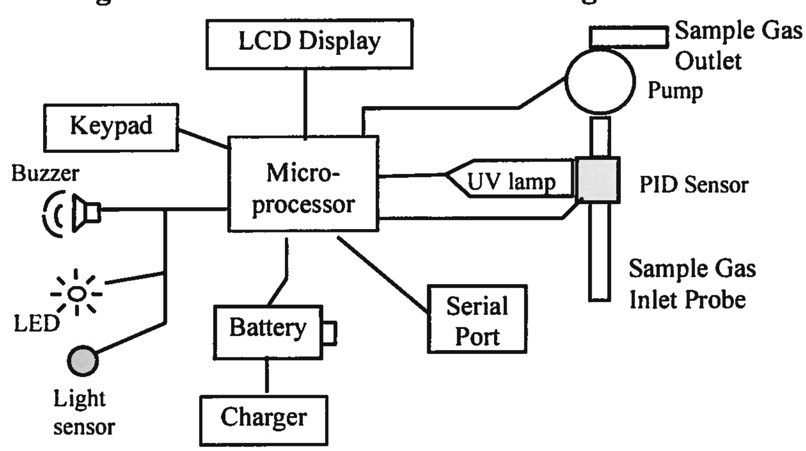
1. To exit programming mode from the first tier menu level, press the **[MODE]** key once.
2. To exit programming mode from 2nd tier sub-menu, press the **[MODE]** key twice.
3. To return to programming mode, press and hold down both the **[MODE]** and **[N/-]** keys for 3 seconds.

5. THEORY OF OPERATION

The MiniRAE 2000 monitor uses a newly developed electrodeless discharge UV lamp as the high-energy photon source for the PID. As organic vapors pass by the lamp, they are photo-ionized and the ejected electrons are detected as a current. The PID sensor with a standard 10.6 eV lamp detects a broad range of organic vapors. A lamp with high photon energy (e.g. 11.7 eV) will measure the more kinds of compounds, whereas low photon energies (e.g. 9.8 eV) are selective for easily ionizable compounds such as aromatics. In principle, any compound with an ionization energy lower than that of the lamp photons can be measured.

The PID sensor for the MiniRAE 2000 monitor is constructed as a small cavity in front of the UV lamp. A diaphragm pump draws the gas sample into the sensor and then pumps it out through the side of the instrument.

Figure 5-1 MiniRAE 2000 Block Diagram



A single chip microcomputer is used to control the operation of the alarm buzzer, LED, pump and light sensor. It measures the sensor readings and calculates the gas concentrations based on calibration to known standard gases. The data are stored in non-volatile memory so that they can be sent to a PC for record keeping. RS-232 transceivers provide a serial interface between the monitor and the serial port of a PC. An LCD display consisting of a single row of eight alpha/numeric characters is used to display the readings. The user interacts with the monitor through three keys on the front panel keypad.

A rechargeable NiMH, NiCd battery, or an alkaline battery pack powers the monitor.

6. MAINTENANCE

The major maintenance items of the MiniRAE 2000 are:

- Battery pack
- Sensor module
- PID lamp
- Sampling pump
- Inlet connectors and filters

Note: Maintenance should be performed by qualified personnel only.

NOTE: The printed circuit board of the monitor is connected to the battery pack even if the power is turned off. Therefore, it is very important to disconnect the battery pack before servicing or replacing any components inside the monitor. Severe damage to the printed circuit board or battery may occur if the battery pack is not disconnected before servicing the unit.

6.1 Battery Charging and Replacement

When the display shows a flashing message "Bat", the battery requires recharging (see Section 3.1 for Battery charging). It is recommended to recharge the MiniRAE 2000 monitor upon returning from fieldwork. A fully charged battery runs a MiniRAE 2000 monitor for 10 hours continuously. The charging time is less than 10 hours for a fully discharged battery. The built-in charging circuit is controlled by the micro-controller to prevent over-charging. The battery may be replaced in the field (in area known to be non-hazardous) if required.

WARNING
To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non- hazardous. Remove and replace battery only in area known to be non-hazardous.

Replacing Battery Pack

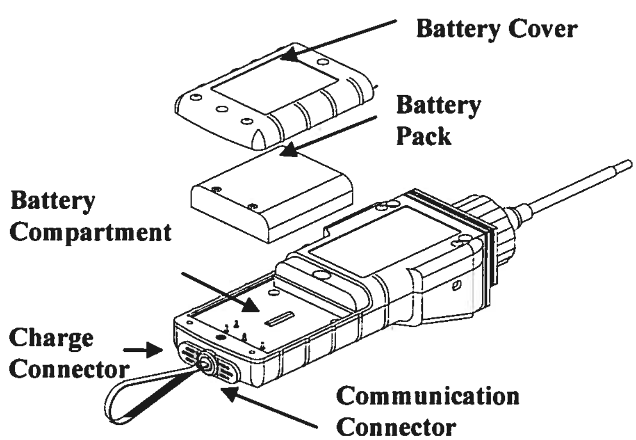


Figure 6-1 Battery Replacement

1.

Turn off the power of the MiniRAE 2000.

2. Unscrew the two battery compartment screws, located on the bottom of the monitor, and remove the cover.
3. Remove the battery pack from the battery compartment.
4. Replace a fully charged spare battery pack inside the battery compartment. Make sure the battery pack is oriented properly inside the compartment
5. Close the battery cover and tighten the two screws.

Replacing Alkaline Battery Adapter

1. Insert four fresh AA size alkaline batteries into the alkaline battery holder. Make sure that the polarity of the batteries is correct.
2. Follow the same procedure as described above to replace the battery holder.

Note: The internal charging circuit is designed to prevent charging to alkaline batteries.

6.2 PID Sensor & Lamp Cleaning/Replacement

The sensor module is made of several components and is attached to the lamp-housing unit as shown in Figure 7-2.

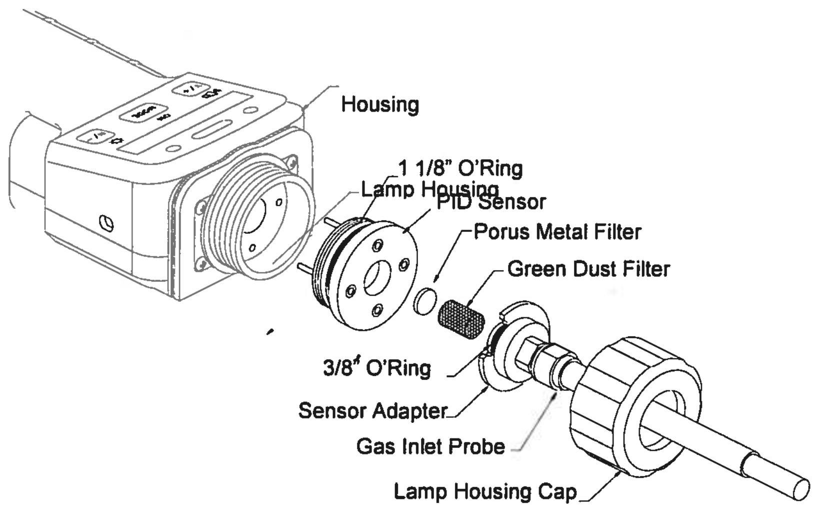


Figure 7-2 Sensor Components

Note: Normally the cleaning procedure is not needed. Clean the PID sensor module, the lamp and the lamp housing only when one of the following happened:

1. The reading is inaccurate even after calibration.
2. The reading is very sensitive to air moisture.
3. A chemical liquid has been sucked into the unit and damaged the unit.

Use of the water trap filter will help prevent contamination and accidentally drawing liquid into the sensor.

To access the sensor components and lamp, gently unscrew the lamp-housing cap, remove the sensor adapter with the gas inlet probe and the metal filter all together. Then hold the PID sensor and pull straight out to avoid bending the electrical pins on the sensor (see Figure 7-2). A slight, gentle rocking motion helps release the sensor.

To clean the PID sensor:

Place the entire PID sensor module into GC grade methanol. It is highly recommended that an ultrasound bath to be used to clean the sensor for at least 15 minutes. Then dry the sensor thoroughly. Never touch the electrodes of the sensor by hand.

Also use a methanol-soaked cotton swab to wipe off the lamp housing where it contacts the sensor when the sensor is installed.

Turn over the sensor so that the pins point up and the sensor cavity is visible. Examine the sensor electrodes for any corrosion, damage, or bending out of alignment. The metal sensor electrode "fingers" should be flat and straight. If necessary, carefully bend the sensor fingers to ensure that they do not touch the Teflon portions and that they are parallel to each other. Make sure that the nuts on the sensor pins are snug but not overtight. If the sensor is corroded or otherwise damaged, it should be replaced.

To clean lamp housing or change the lamp:

To clean lamp housing or change the lamp:

If the lamp does not turn on, the monitor will display an error message to indicate replacement of the lamp may be required.

1. If the lamp is operational, clean the lamp window surface and the lamp housing by wiping it with GC grade methanol using a cotton swab using moderate pressure. After cleaning, hold the lamp up to the light at an angle to detect any remaining film. Repeat the process until the lamp window is clean. Never use water solutions to clean the lamp. Dry the lamp and the lamp housing thoroughly after cleaning.

   CAUTION: Never touch the window surface with the fingers or anything else that may leave a film. Never use acetone or aqueous solutions.

2. If the lamp does not turn on, remove the lamp from the lamp housing. Place the lamp O-ring onto the new lamp. Insert the new lamp, avoiding contact with the flat window surface.
3. Reinstall the PID sensor module.
4. Tighten the Lamp Housing Cap.
5. If the lamp type has been changed, adjust the lamp type setting in the programming mode (Section 4.7.8).

6.3 Sampling Pump

When approaching the end of the specified lifetime of the pump, it will consume higher amount of energy and reduce its sample draw capability significantly. When this occurs, it is necessary to replace or rebuild the pump. When checking the pump flow, make sure that the inlet connector is tight and the inlet tubing is in good condition. Connect a flow meter to the gas inlet probe. The flow rate should be above 450 cc/min when there is no air leakage.

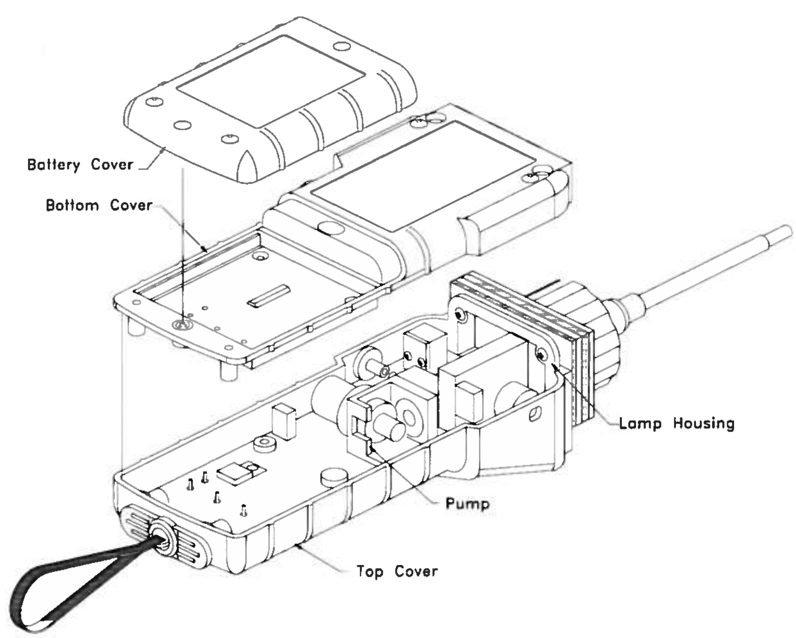


Figure 7-3 Sampling Pump

Pump Replacement

1. Turn off the MiniRAE 2000 power.
2. Open the battery cover, remove the battery pack, and carefully unscrew the six screws to open the bottom cover.
3. Unplug the pump from the PCB. Unscrew the two screws that hold the pump assembly to the PCB. Disconnect the Tygon tubing that connects the pump to the gas inlet port and gas outlet port.
4. Insert a new pump assembly. Connect the Tygon tubing to the gas inlet port. Plug the pump connector back into the PCB and screw down the pump assembly to the board.
5. Replace the bottom cover and tighten the six screws. Re-connect the battery pack. Replace the battery pack and its cover.

6.4 Turning on the UV Lamp

The UV lamp is made of a glass envelope and a UV window (salt crystal) on one end of the envelope. The inside of the lamp is filled with low pressure gases. To turn on the lamp, a high voltage electric field is applied from the outside of the glass envelope. The molecules inside the lamp are ionized and produce a glow discharge that generates the UV light. The MiniRAE 2000 has a built-in sensing mechanism to monitor the status of the UV lamp and display a "Lamp" error message if it is not on.

If the UV lamp has not been used for a long period of time (> 1 month) or is cold, it may become slightly harder to turn on. If such a condition occurs, the "Lamp" message will appear in the monitor display during the power on sequence. This phenomenon is more significant in 0.25" UV lamps used in ToxiRAE and MultiRAE Plus products, because of the relatively small lamp size. To solve this problem, simply turn on and off the monitor a few times and the lamp should turn on. After the UV lamp is turned on for the first time, it should be easier to turn on the UV lamp next time.

It is possible that the UV lamp is actually on when the lamp error message appears. This is because when the lamp becomes old, the internal threshold level to detect lamp failure may have shifted and cause a false alarm. To eliminate such possibility, simply check to see the UV lamp is actually on. This can be done easily by removing the sensor cap and observing the glow light of the UV lamp in a dark place. The user can also feed the monitor with calibration gas and observe if the sensor reading changes. If the reading changes significantly with the gas, the UV lamp is actually on.

A possible failure mechanism for the UV lamp is a leak developed along the seal of the glass envelope. When such condition occurs, the lamp will become very hard or impossible to turn on and will need to be replaced.

7. TROUBLESHOOTING

To aid the user in diagnosing the monitor, a special diagnostic mode can be used displays critical, low level parameters. Section 7.1 describes the operation of the diagnostic mode. Section 7.2 summarizes the frequently encountered problems and suggested solutions. By turning on the MiniRAE 2000 monitor in diagnostic mode and by using the troubleshooting table in Section 7.2, the user can usually correct the problem without having to return the monitor for repair.

WARNING

This function should be used by qualified personnel only! The diagnostic mode allows the user to set several low-level parameters that are very critical to the operation of the monitor. Extra care should be taken when setting these parameters. If the user is not familiar with the function of these parameters and sets them incorrectly, it may cause the monitor to shut down or malfunction.

7.1 Troubleshooting Table

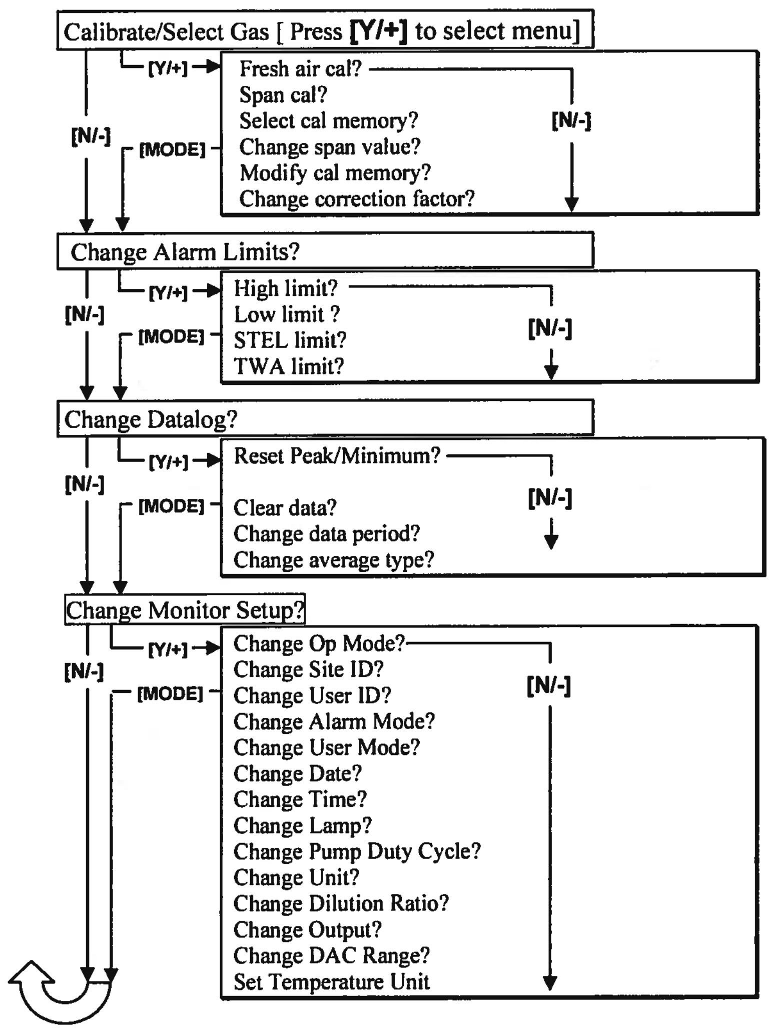
Problem	**Possible Reasons & Solutions**
Cannot turn on power after charging the battery	**Reasons:** Discharged battery. Defective battery. Microcomputer hang-up. **Solutions:** Charge or replace battery. Disconnect, then connect battery to reset computer.
No LCD back light	**Reasons:** Trigger level too low, the current mode is not user mode, and the mode does not support automatic turn on back light. **Solutions:** Adjust trigger level. Verify the back light can be turned on in user mode. Call authorized service center.
Lost password	**Solutions:** Call Technical Support at +1.408 .752 .0723 or +1. 888 .723 .4800
Reading abnormally High	**Reasons:** Dirty sensor module. Dirty water trap filter. Excessive moisture and water condensation. **Solutions:** Clean sensor module and lamp housing. Replace water trap filter. Blow dry the sensor module.
Buzzer Inoperative	**Reasons:** Bad buzzer. **Solutions:** Call authorized service center.

Inlet flow too low	**Reasons:**	Pump diaphragm damaged or has debris. Flow path leaks.
	Solutions:	Check flow path for leaks; sensor module O-ring, tube connectors, Teflon tube compression fitting. Replace pump or diaphragm.
"Lamp" message during operation	**Reasons:**	Lamp drive circuit. Weak or defective PID lamp, defective.
	Solutions:	Turn the unit off and back on Replace UV lamp
Full scale measurement in humid environment	**Reasons:**	Dirty or wet sensor.
	Solutions:	Clean and dry sensor and lamp housing. Adjust sensor fingers to ensure not touching Teflon. Use water trap filter.
Reading abnormally low	**Reasons:**	Incorrect calibration. Low sensitivity to the specific gas. Weak or dirty lamp. Air leakage.
	Solutions:	Calibrate the monitor. Replace sensor. Clean or replace lamp. Check air leakage.

APPENDIX A. QUICK REFERENCE GUIDE

Press [N/-] and [MODE], simultaneously, for 3 seconds, to enter Programming Mode. Press [MODE] to return to Survey Mode.

PROGRAMMING MODE



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Technical Service: 888-723-4800
Tech@raesystems.com

Special Note

If the monitor needs to be serviced, contact either:

1. The RAE Systems distributor from whom the monitor was purchased; they will return the monitor on your behalf.
2. The RAE Systems Technical Service Department. Before returning the monitor for service or repair, obtain a Returned Material Authorization (RMA) number for proper tracking of your equipment. This number needs to be on all documentation and posted on the outside of the box in which the monitor is returned for service or upgrade. Packages without RMA Numbers will be refused at the factory.

ATTACHMENT B

Field Soil Boring/Rock Coring Logging Procedures and Classification Systems, Dresdner Robin, Sept, 2003

DRESDNER ROBIN

SOP

FIELD SOIL BORING/ROCK CORE LOGGING PROCEDURES AND CLASSIFICATION SYSTEMS

September 2003

TABLE OF CONTENTS

ATTACHMENTS

I. INTRODUCTION

This standard operating procedure (SOP) describes field methods and procedures to be utilized by DRESDNER ROBIN personnel during soil and rock core drilling and sampling programs. The specific methods and procedures addressed include examination and description of soil and rock core samples and the recording of various technical information, test data, and field observations during drilling and well installation activities. Examples of relevant technical information and other data and observations would include split-spoon sample blow counts, soil sample/core recovery, environmental and health and safety test data (PID, CGI, etc.), physical evidence of contamination, geologic and hydrogeologic information, monitoring well construction details, and material specifications.

The methods and procedures described below were selected because they are considered industry standards, and/or are in wide use in the environmental/geotechnical industries today. Therefore, these methods and procedures will be recognized and accepted by both clients and regulatory agents.

Included in this SOP are the following:

- DRESDNER ROBIN'S; Field Soil Boring and Coring/Well Logs, designed using WINLOG Software;
- The Bermister Soil Classification System, and modifications thereof;
- The Unified Soil Classification System (USCS);
- Standardized terminology for rock core descriptions;
- Field Aids for use during field logging;
- List of Standardized abbreviations
- Field Equipment Check Lists;
- American Society of Testing Materials (ASTM) Standards;
- Other applicable references/reference materials.

II. FIELD SOIL BORING/WELL LOG

DRESDNER ROBIN'S Soil Boring/Well Log and accompanying Lithologic Legend is presented in Attachment 1. The Soil Boring/Well Log was developed using WINLOG by modifying one of the commonly used templates provided with the program.

To save time in the field, the header of the field log can be partially filled out using the WINLOG program in the office to include borehole/well designations, project and client information, and other information, if known. If borings/wells greater than 30 feet are planned, the depth column can be modified in Winlog so that the approximate total depth and exact number of field log pages needed can be printed out. The Winlog File designation for the Boring/Well Log is *DRSoilBoring&WellLog2.*

Utilizing the field log form will help ensure that the most important geological, environmental, and technical information is recorded for each soil boring and monitoring well. Furthermore, the data recorded on the field logs can be efficiently input into the WINLOG Software Program to produce a Final Log Report.

Copies of all field logs must be made by the field geologist/inspector as soon as possibly upon return to DRESDNER ROBIN'S office, and the original field logs placed in the project/central files.

A description of each log header and the information to be recorded on the field Soil Boring/Well Log is presented below.

Log Header: Borehole/Well Designation (if applicable); DRESDNER ROBIN Project No; Project Name; Client; Location of Site (or location of boring on the Site; Northing and Easting (if known); Elevation (Top of Casing or otherwise as designated); Total Depth; Water Level (measured or as interpreted from boring log data); Sampling Method (split-spoon or Geoprobe); Sample Interval; and Logged By (Field geologist or inspector).

Log Footer: Drilling Company; Driller; Drilling Method (i.e. rig type); Auger Size (inside and outside diameter); Hole Diameter; Casing diameter (PVC or steel); Date Start; Date Finish: Checked By (Final Log report only); and Sheet (1 of 2, 2 of 2,etc.).

COLUMN ENTRIES:

Sample #: Sample designation (only for samples collected for *environmental* or *geotechnical* laboratory analysis.

Blow Counts: Blow counts per 6-inches of split spoon penetration or part thereof (if applicable).

Recovery: Sample recovery in inches as measured with a ruler directly from the split spoon or other sampling device.

VOC: Highest concentration of volatile organic vapors in parts per million (ppm), as measured for every 6 inches of sample, with the PID.

Depth: As measured below the ground surface, in 0.5 feet and 1-foot intervals, 16 feet per page;

Symbol: Not recorded (generated by WinLog in the Final Log Report)

Description: Bermister Soil Description with Unified Soil Classification System (USCS) designation; a description/USCS designation is generally recorded every 2 feet during split spoon or Geoprobe sampling unless the lithology is very uniform, in which case "SAME AS ABOVE" may be substituted for the sample description (if split-spoon/Geoprobe samples are not collected, samples should be collected from the auger at the same frequency); depths of major lithologic changes should be determined to the nearest 0.5 feet; thickness of lenses should be measured in inches.

Formation: Lithologic or Geologic Formation Name, such as Fill, Glacial Formation, outwash, till, Englishtown Formation (Ket), etc.; lines can be drawn across the Description and Formation Columns designating the contact between the lithology/formation.

Remarks: Include observation on physical evidence of contamination (stain, odor, sheen, etc.), as well as important drilling and other technical information.

Well Completion Details: Details and depths of the well screen/casing intervals, sand pack, bentonite seal, concrete pad, water level, and total depth should be drawn in this column; notes on well material specifications and volume/length of materials used can also be recorded in this column.

Elevation: Not recorded (elevation of ground surface as determined by a surveyor is input into the final WinLog Report).

A Bermister Soil Identification Method

The Bermister Soil Identification Method emphasizes the description of soil based upon the recognizable and distinguishable characteristics of the soil, primarily composition, gradation, and plasticity. The method is based upon various practical field and lab procedures utilized for identifying soils, and therefore, has found wide use in the engineering/environmental field.

DRESDSNER ROBIN utilizes the basic Bermister Method for field sample descriptions modified to include moisture content, and organic content, if any. In addition, environmental quality (i.e., stain, sheen, odor, etc.) and geologic unit or origin of deposit is recorded.

The basic descriptive elements and the order to be recorded on the field log are as follows:

- Color (from Munsell Color Chart)
- PRINCIPAL Component > 50% (SAND, GRAVEL, SILT or CLAY)
- Grain Size: c - m < 10% fine sand (or gravel)
  m - f < 10% coarse sand (or gravel)
  c – f > 10% all components
  f < 10% coarse and medium sand (or gravel)
  m < 10% fine and coarse sand (or gravel)
  c < 10% medium and fine sand (or gravel)
- Minor Componants - 'and' 30-50%
  'some' 20-35%
  'little' 10-20%
  'trace' 1-10%
- Moisture Content - 'Dry'
  'Moist'
  'Wet'
- Organic Content (type, frequency, size, etc.)
- Environmental Quality (petroleum odor, stain, sheen, etc.)

For example, a typical Bermister sample description would read "Brown medium through coarse SAND, little fine Gravel, trace of Silt, dry" or "Reddish Brown Silty CLAY, trace of fine Sand, moist". If a particular grain size in the sample is the dominant grain size or if it comprises a minor portion of sample, it would be further identified as fine (+) or coarse (-), respectively.

In addition to the Bermister description, the Unified Soil Classification System (USCS) should be determined for each sample examined (Section II.B). Other descriptive qualifiers should also be noted where appropriate, and may include stratification, structure, density/consistency, grain angularity, and other distinguishing engineering or geologic characteristics. Field guides and aids that should be used as reference during the soil sample examination procedure are provided in Attachment 2 including the following:

- Field Aids for the Bermister Identification Method and the USCS System;
- Grain Size Scale and Graphs;
- Density and Consistency Charts;
- Other useful information

Note that many of the charts and other information provided in Attachment 2 can be found in the back of the Field Notebook and can be easily used for direct comparison with the sample being examined. To conserve space on the field log, standardized abbreviations may be used when recording field descriptions. A list of Standard Abbreviations for Lithologic Descriptions is provided as Attachment 3. The reference document that describes the Bermister Method "Suggested Test Methods for Identifying Soil" is provided in Attachment 4.

B Unified Soil Classification System (USCS)

The USCS is an engineering soil classification system that categorizes soil based upon grain size and plasticity. The USCS uses a two-letter symbol for soil classifications. The first letter of the symbol describes the grain size characteristics of the sample and the second letter describes the grain size distribution of granular soil or the plasticity of fine grain soil (i.e., passing through the No. 200 Sieve). The letters of the USCS symbols are as follows:

First Letter	Second Letter
S= >50% Sand	P= poorly graded/well sorted (1 or 2 grain sizes)
G= >50% Gravel	W=well graded/poorly sorted (> 2 grain sizes)
S= >50% Silt	C= clayey
C= >50% Clay	M= silty
O= Organic Soil	L= low-plastic
	H= high plastic

Examples of common USSC soil classifications would be SP (poorly graded sand), GW (well-graded gravel); GM (silty gravel), ML (low-plastic silt). OL (low plastic organic soil), etc. Borderline classifications are designated by hyphenated symbols such as SP-SM, ML-CL, etc. If the sample is composed of coarse granular materials resulting from the weathering of bedrock, the term "rock fragments' may be used.

The appropriate USCS symbol should be recorded on the field log by the geologist or inspector in parentheses following the Bermister description. An abbreviated summary of the USCS classification system and related field aides is provided in Attachment 2. A detailed description of the USCS Classification System (ASTM Standard D 2487-92, *Classification of Soils For Engineering Purposes*) is provided in Attachment 3, as is ASTM D-2488-90, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).*

IV FIELD CORING/WELL LOG

DRESDNER ROBIN'S field log for use during rock coring is presented in Attachment 1. Similar to the Soil Boring/Well Log discussed above, the Coring/Well Log was developed using WINLOG by modifying one of the example logs provided with the program. The Winlog File designation for the Coring/Well Log is Coring/WellDetails3.

If a shallow test boring is conducted in overburden materials at the same location that is cored, the field soil boring/well log as described in Section II. can be used to log the overburden material. A note should then be placed at the bottom of the log that reads "SEE CORING LOG FOR BEDROCK LITHOLOGY AND WELL DETAIL". If no coring is being conducted but a bedrock monitoring well is installed, the field soil boring/well log can also be used to record the bedrock well details. During the well installation, samples of cuttings (typically air-rotary cuttings) should be collected every five feet and the description recorded on the soil boring/well log.

Core Examination

Prior to the beginning the core run, the Client name, the name of the Site, the Core/Monitoring Well designation number, and the coring date should be marked on the outside of the box with a permanent black felt-tipped pen. The Run Number, Core depths, % Recovery, and RQD should be marked on the inside of the core box cover (this information is also recorded on the Coring Log). To facilitate the examination and logging of the core, the wooden dividers inside the box can be marked in one-foot intervals with the actual depth of the core. The core pieces that represent drilling breaks (smooth clean breaks as distinct from joints and fractures) should be marked with a felt tipped pen; if a piece of core is purposely broken in order to fit it into the box, the artificial break should be noted. Where the % recovery is less than 100%, wooden inserts or other materials can be placed between the core run dividers to secure the core inside the box.

Following completion of each core run, the geologist can describe the core in accordance with standard terminology and practice as described in Section III A. After completion of the core, the core should be photographed and the boxes stored on-site (at a location designated by the Site manager) until the project is completed.

A description of each log header and the information to be recorded on the field Coring/Well Log is presented below.

Log Header: Same as described above for Soil Boring/Well Log.

Log Footer: Same as described above for Soil Boring/Well Log.

<u>COLUMN ENTRIES:</u>

Run/% Recovery: Core Run Number (i.e., Run #1, Run #2), the bottom of the run being marked by placing a line across the column; the % Recovery is calculated and placed in this column below the Run Number, as defined by the following:

$$\% \text{ Recovery} = \text{Length of core recovered} \div \text{Total Length of Run} \times 100$$

RQD: The Rock Quality Designation (RQD) is a measure of the structural integrity of the rock and indicates the degree of fracture porosity. The RQD is calculated for each Run and placed in this column. RQD is defined as:

RQD = Total length of all pieces in Run greater than 4 inches ÷
Total Length of Core Run X 100

Dip Angle: Dip of fractures planes, in degrees, as measured from the horizontal plane (parallel to the land surface); may or may not be parallel to bedding planes. For example, a 90 degrees dip angle would be a vertical dip; no orientation of the dip angle is possible due to the 'spinning' of the core in side the core barrel. At a minimum, dip angles should be recorded at all changes in dip and for all vertical or near vertical dips.

Fractures/Foot: The number of fractures for each foot of core in this column; include only natural breaks (i.e., those that do not fit together neatly, and show evidence of weathering, discoloring, mineralization, etc.)

VOC: The concentration of volatile organic vapors in parts per million (ppm), as measured with the PID, for every foot of core.

Depth: As measured below the ground surface, in 0.5 feet and 1-foot intervals, 16 feet per page;

Symbol: Generally not recorded (generated by WinLog in the Final Log Report)

Lithology: A description of the lithology of the rock core using standardized rock classifications and terminology pertaining to color, rock type, hardness, fracturing, weathering, stratification, mineralogy (if observable), plus and other distinguishing characteristics.

Formation: Lithologic or Geologic Formation Name, such as Brunswick Shale, diabase, Stockton Sandstone, etc.; lines can be drawn across the Description and Formation Columns designating the contact between different lithologies and formations.

Remarks: Include observation on physical evidence of contamination (stain, odor, sheen, etc.), as well as important drilling and technical information.

Well Completion Details: Details and depths of the bore hole diameter**,** well screen and casing intervals, sand pack/bentonite/grouting intervals, water level information, and total depths should be drawn in this column; notes on well material specifications and volume/length of materials used can also be recorded in this column.

Elevation: Not recorded (elevation of ground surface as determined by a surveyor is input into the final WinLog Report).

A Standardized Rock Classification System

An industry-wide standard classification system has not been established for description of rock cores. The system that is described below is based on U.S. Environmental Protection Agency (USEPA) Guidelines for Borehole and Sample Logging that was prepared for their ARCS II Program. Additional, information on geotechnical properties of rock and definitions of important rock characteristics is provided in ASTM D653-90, *Standard Terminology Relating to Soil, Rock, and Contained Fluids* (Attachment3).

The rock classification system presented below should be used for all rock core descriptions. The descriptive information is recorded by the field geologist or inspector directly into the Lithologic Column on DRESDNER ROBIN'S Coring/Well Log. The descriptive elements of the Rock Classification System, in the order that they should be described and recorded, are as follows:

- Color (from Munsell Color Chart)
- Rock Type: -Sedimentary: sandstone, conglomerate, siltstone, shale, limestone
  -Igneous: basalt, granite, diabase, pegmatite, volcanic, etc.
  -Metamorphic: gneiss, schist, granite, etc.
  -Others: based upon geographic location
- Hardness: -very weak
  -weak
  -medium strong
  -strong
  -very strong
- Fracturing: -very broken - < 2-in. (spacing between natural fractures)
  -broken - 2-in. to 1-ft.
  -blocky - 1 to 3 ft.
  -massive - 3 to 10 ft.
- Weathering: -fresh - little or no staining
  -slight - some staining and clay filling in fractures
  -moderate - heavy staining, can be broken with hammer
  -severe - entirely stained, very weak, soil-like
- Bedding: -very thick - > 3.3 ft.
  -thick bedded - 1.0 in. to 3.3 ft.
  -medium bedded – 4.0 in. to 1.0 ft.
  -thin bedded- 1.0 in. to 4.0 in.
  -very thin - ½ in to1 in.
  -laminated - $^1/_8$ in to ½ in
  -thinly laminated - < $^1/_8$ in
- Other: -Description of mineralogy, cavities or vugs,
  -Nature or contacts; other distinguishing features

Standardized abbreviations for the bedrock formation names and important rock qualifiers are included in Attachment 1. A field aid for help in rock classifications and descriptions is provided in Attachment 2. The major bedrock formations of New Jersey, the stratigraphic units and their predominant lithology are also provided in Attachment 4.

IV FIELD EQUIPMENT

The following is a list of standard equipment and other materials that are commonly used during the sample examination/logging procedure, and during collection of the sample (i.e., by split-spoons, direct-push, coring, etc.). Equipment needs for environmental sample collection and for health and safety are also listed.

All Sample Examination

- [ ] Field Notebook
- [ ] Soil Boring Logs
- [ ] Munsell Color Chart
- [ ] Aluminum Clipboard
- [ ] Waterproof pens
- [ ] Ruler or tape measure
- [ ] Knife or steel blade
- [ ] Magnifying lens
- [ ] Ziploc bags
- [ ] Clear glass jars

Rock Core Examination

- [ ] Coring Log
- [ ] Waterproof black Marker
- [ ] Protractor
- [ ] Dilute Acid (HCl)
- [ ] Rock hammer

Health and Safety/Environmental Monitoring

- ☐ HASP
- ☐ Latex Gloves
- ☐ Ear plugs
- ☐ Safety Goggles
- ☐ Photoionization Meter (PID)
- ☐ Combustible Gas Indicator (if required)
- ☐ First Aid Kit
- ☐ Fire Extinguisher

Sampling Equipment

- ☐ En-Core Sampler or Equivalent
- ☐ Rubber Gloves
- ☐ Stainless Steel Bowls and Trowels
- ☐ 5-Gallon Buckets
- ☐ Spray Bottles
- ☐ Potable water supply
- ☐ Wire Brushes
- ☐ Scrub Brushes
- ☐ Alconox or Equivalent
- ☐ Distilled water
- ☐ Acetone or Dilute Nitric Acid (if required)
- ☐ Paper towels and wipes
- ☐ Plastic sheeting
- ☐ Trash bags

ATTACHMENT 1

Soil Boring/Well Details:

Project No:
Project:
Client:
Location:

Northing:
Easting:
Elevation:
Total Depth:

Water Level:
Sampling Method:
Sample Interval:
Logged By:

SAMPLE				SUBSURFACE PROFILE						
Sample #	Blow Counts	Recovery	VOC (PPM)	Depth (ft\m)	Symbol	Description	Formation	Remarks	Well Completion Details	Elevation (FT.MSL)
				1						
				2						
				3 — 1						
				4						
				5						
				6 — 2						
				7						
				8						
				9						
				10 — 3						
				11						
				12						
				13 — 4						
				14						
				15						

Drilling Company:
Driller:
Drilling Method:
Auger Size:
Hole Diameter:

DRESDNER ROBIN
371 Warren Street
P.O. Box 38
Jersey City, NJ 07302

Casing Diameter:
Date Start:
Date Finish:
Checked By:
Sheet:

Soil Boring/Well Details:

Project No:
Project:
Client:
Location:

Northing:
Easting:
Elevation:
Total Depth:

Water Level:
Sampling Method:
Sample Interval:
Logged By:

SAMPLE				SUBSURFACE PROFILE						
Sample #	Blow Counts	Recovery	VOC (PPM)	Depth	Symbol	Burmister Soil Description (USCS Classification)	Formation	Remarks	Well Completion Details	Elevation (Ft.)
				16						
				5						
				17						
				18						
				19						
				6						
				20						
				21						
				22						
				23 / 7						
				24						
				25						
				26						
				8						
				27						
				28						
				29						
				9						
				30						

Drilling Company:
Driller:
Drilling Method:
Auger Size:
Hole Diameter:

DRESDNER ROBIN
371 Warren Street
P.O. Box 38
Jersey City, NJ 07302

Casing Diameter
Date Start:
Date Finish:
Checked By:
Sheet:

Coring/Well Details:

Project No.
Project:
Client:
Location:

Northing:
Easting:
Elevation:
Total Depth:

Water Level:
Sampling Method:
Sample Interval
Logged By:

Run/ % Recovery	RQD	Dip (degrees %)	Fractures/Ft. 5 15	VOC (ppm)	Depth (ft./m)	Symbols	LITHOLOGIC DESCRIPTION	Formation	Remarks	Well Completion Details	Elevation (Ft.)
					1						1
					2						0
					3 / 1						-1
					4						-2
					5						-3
					6 / 2						-4
					7						-5
					8						-6
					9						-7
					10 / 3						-8
					11						-9
					12						-10
					13 / 4						-11
					14						-12
					15						-13

Drilling Company:
Driller:
Drilling Method:
Auger Size
Hole Diameter:

DRESDNER ROBIN
371 Warren Street
P.O. Box 38
Jersey City, NJ 07302

Casing Diameter:
Date Finish:
Date Start:
Checked By:
Sheet:

Coring/Well Details:

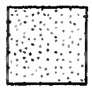
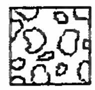
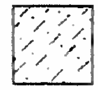
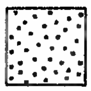
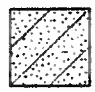
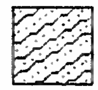
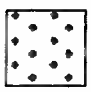
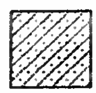
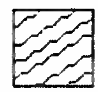
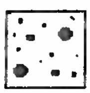
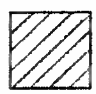
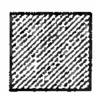
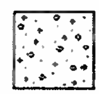
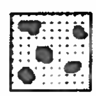
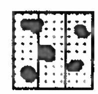
Project No.	**Northing:**	**Water Level:**
Project:	**Easting:**	**Sampling Method:**
Client:	**Elevation:**	**Sample Interval**
Location:	**Total Depth:**	**Logged By:**

Run/ % Recovery	RQD	Dip (degrees %)	Fractures/Ft. 5 15	VOC (ppm)	Depth (ft./m)	Symbols	LITHOLOGIC DESCRIPTION	Formation	Remarks	Well Completion Details	Elevation (Ft.)
					16						-14
					5						
					17						-15
					18						-16
					19						-17
					6						
					20						-18
					21						-19
					22						-20
					23 — 7						-21
					24						-22
					25						-23
					26 — 8						-24
					27						-25
					28						-26
					29						-27
					9						
					30						-28

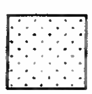
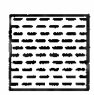
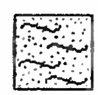
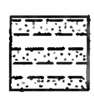
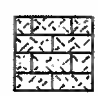
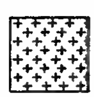
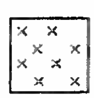
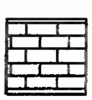
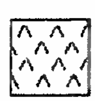
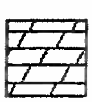
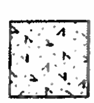
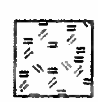
Drilling Company:	**DRESDNER ROBIN**	Date Start:
Driller:	371 Warren Street	Casing Diameter:
Drilling Method:	P.O. Box 38	Date Finish:
Auger Size	Jersey City, NJ 07302	Checked By:
Hole Diameter:		Sheet:

Lithologic Library

Lithologic Symbols and USCS Classification

	Fine or medium to fine Sand (SP)		Gravel or Silty/Clayey Gravel (GP/GW or GM/GC)		Silty Sand (SM)
	Medium Sand (SP)		Clayey Sand (SC)		Sandy Silt or Silt (ML)
	Coarse to medium Sand (SP)		Sandy or Silty Clay (CL or CL/ML)		High Plastic Silt or Clayey Silt (MH)
	Coarse through fine Sand (SW)		High plastic Clay (CH)		Interbedded Sand and Silt (SP and ML, etc.)
	Gravely Sand (SW or SP)		Organic Clay or Silt (OL)		Native Fill Material
	Sand and Gravel (SW-GW, SP-GW, etc.)		Weathered Bedrock		Miscellaneous Fill Material

Bedrock Symbols

	Sandstone		Mudstone		Quartzite
	Siltstone		Interbedded Sandstone and Shale		Marble
	Shale		Granite		Schist
	Conglomerate		Diabase		Slate
	Limestone		Basalt		Gneiss
	Dolomite		Volcanic Extrusive		Pegmatite

Symbol Legend

Well Symbols

Well Covers

- Screw-on
- Expanding Locking
- Snap-on
- PVC Hinged
- Steel Hinged
- Plug PVC Locked
- Aluminum Locked
- Steel Locked
- Open
- Bolt - down Flush - mounted
- Well Vault
- Well Vault

Well Caps

- Screw-on
- Steel Screw-on
- Plug
- Push-on
- Push-on Plug
- Push-on
- Steel Push-on
- Push-on Cone
- Screw-on Cone
- Open
- Screw-on
- Steel Screw-on

Casings and Screens

- PVC Riser Pipe
- Stainless Steel Riser Pipe
- Casing
- Plug
- Slot 10 Screen
- Slot 20 Screen
- Slot 20 Stainless Screen
- Slot 20 PVC Screen
- Slot 10 PVC Screen
- Slot 10 Stainless Screen
- Slot 10 PVC Screen
- Slot 10 PVC Screen
- Slot 6 Stainless Screen
- Slot 6 PVC Screen
- Slot 6 PVC Screen
- Stainless Screen
- PVC Screen
- PVC Screen
- PVC Prepacked Screen
- Slot 20 PVC Wire Wrap
- Slot 10 PVC Wire Wrap
- Slot 20 Stainless Steel Wire
- Slot 10 Stainless Steel Wire
- Perforated Pipe

Joints and Miscellaneous

- Reducer
- Reducer
- Reducer
- Coupling
- Coupling
- Swivel
- Packer
- Sampling Port
- Cable
- Tube
- Probe
- Bailer

Well Materials

- Silica Sand
- Sand
- Native Fill
- Sand
- Sand and Gravel Fill
- Sand and Gravel Fill
- Gravel
- Gravel
- Pea Gravel
- Clay
- Clay
- Bentonite
- Sandy Clay
- Silty Clay
- Concrete
- Silt
- Concrete
- Concrete

ATTACHMENT 2

MATERIAL CLASSIFICATION

GRANULAR SOILS

SOIL COMPONENTS AND FRACTIONS

Material	Fraction	Size Range
GRAVEL	coarse	1 in. to 3 in.
	medium	3/8 in. to 1 in.
	fine	No. 10 (2 mm) to 3/8 in.
SAND	coarse	No. 30 (.59 mm) to No. 10 (2 mm)
	medium	No. 60 (.25 mm) to No. 30 (.59 mm)
	fine	No. 200 (.074 mm) to No. 60 (.25 mm)
SILT		< No. 200 (.074 mm) and non-plastic
CLAY		< No. 200 (.074 mm) and exhibits plasticity

PROPORTIONS OF COMPONENTS

PRINCIPAL Component		>50%
Minor Components	and	35-50%
	some	20-35%
	little	10-20%
	trace	0-10%

GRANULAR GRADATION

Coarse to fine (cf)	All fractions > 10%
Coarse to medium (cm)	< 10% fine
Medium to fine (mf)	< 10% coarse
Medium (m)	< 10% coarse and fine
Fine (f)	< 10% coarse and med.

SILT - CLAY SOILS

Plasticity and Index		Feel and Smear	Ease of Rolling Threads	Smallest Dia. Thread	Component
Non-Plastic	0	gritty or rough	no threads can be rolled		SILT
Slight	1-5	rough to smooth	difficult	1/4 inch	Clayey SILT
Low	5-10	rough to smooth	less difficult	1/8 inch	SILT & CLAY
Medium	10-20	smooth and dull	readily	1/16 inch	CLAY & SILT
High	20-40	shiny	very readily	1/32 inch	Silty CLAY
Very High	>40	very shiny, waxy	very readily	1/64 inch	CLAY

BERMISTER DESRIPTION

EXAMPLES:
- Brown SILT, trace f Sand.
- Tan mf SAND, little Silt & Clay.
- Gray CLAY, trace f Sand.
- Gray Silty CLAY.
- Brown cf Sand, some f Gravel, some Silt.
- Tan f SAND, little Clayey Silt.

USCS

Symbol	Name	
	Coarse-grained (>50 %)	
GW	Well-graded gravel	<5% fines
GP	Poorly graded gravel	<5% fines
GM	Silty Gravel	>12% silt
GC	Clayey Gravel	>12% clay
SW	Well-graded sand	<5% fines
SP	Poorly graded sand	<5% fines
SM	Silty Sand	>12% silt
SC	Clayey sand	>12% clay
	Fine-grained (>50%)	
CL	Lean Clay	
ML	Silt	
OL	Organic Clay or Silt	
CH	Fat Clay	
MH	Elastic Silt	
OH	Organic Clay or Silt	
PT	Peat, primarily organic matter	

Dual Symbols

Gravels with 5% to 12% fines
- GW-GM well graded gravel with silt
- GW-GC well graded gravel with clay
- GP-GM poorly graded gravel with silt
- GP-GC poorly graded gravel with clay

Sands with 5% to 12% fines
- SW-SM well graded sand with silt
- SW-SC well graded sand with clay
- SP-SM poorly graded sand with silt
- SP-SC poorly graded sand with clay

CL-ML silty clay
GC-GM or SC-SM fines classify as CL-ML

MATERIAL CLASSIFICATION

DENSITY
(Coarse-Grained Soils)

Blows/ft	Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium
31 - 50	Dense
Over 50	Very Dense

CONSISTENCY
(Fine-Grained Soils)

Blows/ft	Manual Penetration	Consistency
<2	Several inches by fist	Very Soft
2 - 4	Several inches by thumb.	Soft
4 - 8	Sev. inches by thumb with moderate pressure.	Med. Stiff
8 - 15	Indented by thumb with great effort.	Stiff
15 - 30	Indented by thumbnail.	Very Stiff
>30	Indented by thumbnail with difficulty.	Hard

MOISTURE CONTENT

DRY	Absence of moisture, dry to touch.
MOIST	Damp but no visible water.
WET	Visible free water, from below W.T.

ANGULARITY

ANGULAR	Sharp edges, plane sides, unpolished surfaces.
SUBANGULAR	Similar to angular but with rounded edges.
SUBROUNDED	Plane sides, well-rounded corners and edges.
ROUNDED	Smoothly curved sides, no edges.

STRUCTURE

LAMINATED	Alternating layers 1/16" to 1/2" thick.
LAYER	1/2" to 12" thick.
LENSES	Lenticular Deposits.
VARVED	Repeated sequence of thinly layered soils.
FISSURED	Breaks along fracture planes.
BLOCKY	Cohesive soil that breaks into small angular clumps along conjugate fissures.
NODULE	Concretion (e.g. iron concretion).
SLICKEN-SIDES	Striated, polished or glossy fracture planes.
STRATIFIED	Interlayered deposits usually containing varying particle size.

Other Structural Terms

GRADED BEDDING
FOSSILIFEROUS
CEMENTED
MICACEOUS
WORM TUBES
RELIC BEDROCK STRUCTURE
DISTORTED
CROSSBEDDING
DISTURBED
CALCAREOUS
HOMOGENEOUS
DISTURBED

DESCRIBING ORGANICS

with wood debris (roots, branches, logs, etc.)
with organic debris (decaying vegetation, etc.)
with lenses of organic debris (peat, muck, etc.)
note frequency (scattered, occasional, frequent)
note size (finely disseminated, 1-inch wood chips, etc.)

GEOLOGIC UNIT OR ORIGIN

Formation name if known or depositional/decompositional origin:
ALLUVIAL (stream deposits)
DELTAIC
COLLUVIAL (talus, residuum)
EOLIAN (loess, dune sand)
ESTUARINE (marsh deposits)
GLACIAL DEPOSITS (till, moraine, eskers, kames)
GLACIO-FLUVIAL (outwash)
LACUSTRINE (lake deposits)
MARINE (marl)
RESIDUAL SOIL (formed in place, no relic structure)
SAPROLITE (intensely weathered, relic structure)
DECOMPOSED ROCK (advanced weathering, friable)
FILL (anthropogenic)

ROCK CLASSIFICATION SYSTEM:

Weathered state, Structure, Color, Grain or Crystal size, Rock material strength, ROCK TYPE

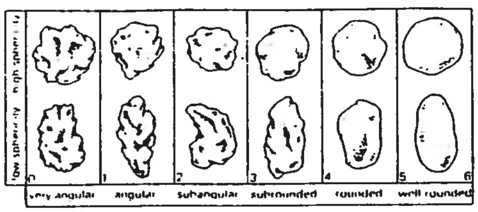
WEATHERED STATE

Term	Description	Grade
Fresh	No visible sign of rock material weathering: perhaps slight discolouration on major discontinuity surfaces.	I
Slightly weathered	Discolouration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discoloured by weathering and may be somewhat weaker externally than in its fresh condition.	II
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a continuous framework or as corestones.	III
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.	IV
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destoyed. There is a large change in volume, but the soil has not been significantly transported.	VI

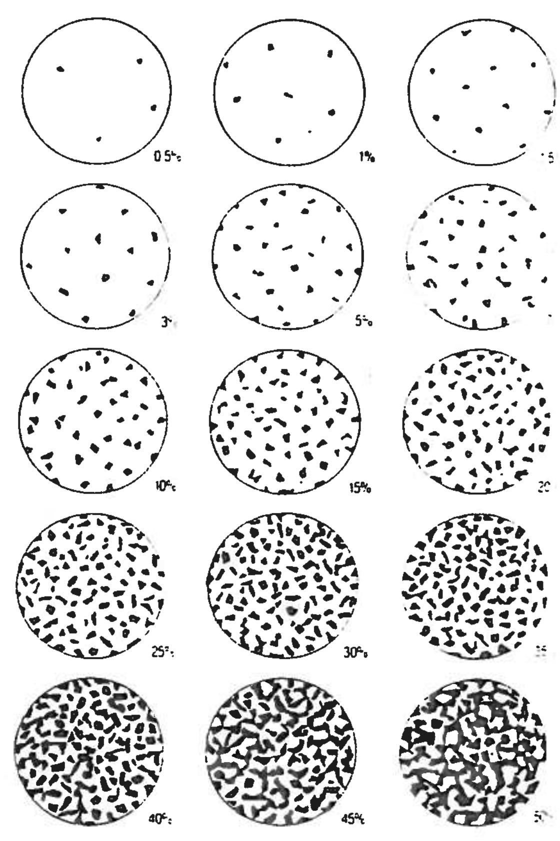
ROCK MATERIAL STRENGTH

Grade	Description	Field identification	Approx range of uniaxial compressive strength (MPa)
S1	Very soft clay	Easily penetrated several inches by fist	<0.025
S2	Soft clay	Easily penetrated several inches by thumb	0.025–0.05
S3	Firm clay	Can be penetrated several inches by thumb with moderate effort	0.05–0.10
S4	Stiff clay	Readily indented by thumb but penetrated only with great effort	0.10–0.25
S5	Very stiff clay	Readily indented by thumbnail	0.25–0.50
S6	Hard clay	Indented with difficulty by thumbnail	>0.50
R0	Extremely weak rock	Indented by thumbnail	0.25–1.0
R1	Very weak rock	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	1.0–5.0
R2	Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	5.0–25
R3	Medium strong rock	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	25–50
R4	Strong rock	Specimen requires more than one blow of geological hammer to fracture it	50–100
R5	Very strong rock	Specimen requires many blows of geological hammer to fracture it	100–250
R6	Extremely strong rock	Specimen can only be chipped with geological hammer	>250

CLAST ROUNDNESS SCALE



DIAGRAMS FOR ESTIMATING PERCENTAGE COMPOSITION BY VOLUME



HAND LENS IDENTIFICATION AND CLASSIFICATION OF COMMON VOLCANIC ROCKS

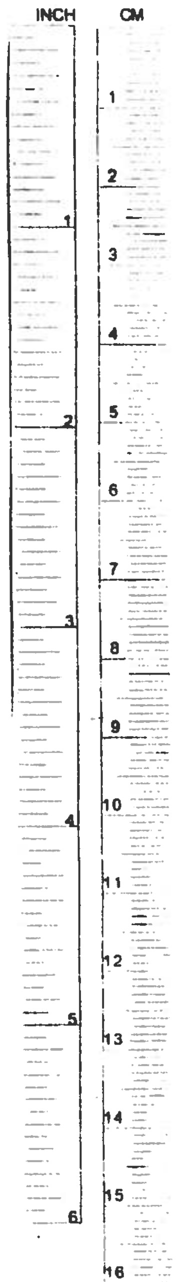
Rock Type*	Qtz	K-spar	Plag	Foids	Comments
Qtz Porphyry	x				
Rhyolite	x	x			
Rhyodacite	x		x		Feldspar not determined
Dacite	x		x		
Qtz Latite	x	x	x		
Latite		x	x		
Trachyte		x			
Trachyandesite			x		Feldspar not determined
Andesite			x		Seldom has olivine, med to dk color
Basalt			x		Frequently has olivine, black
Phonolite		x		x	

*0-12% phenocrysts - no modifier; >12% phenocrysts - rock type porphyry

CLASSIFICATION OF WELL SORTED PYROCLASTIC DEPOSITS AND ROCKS

Clast size	Pyroclast	Unconsolidated	Consolidated
>64 mm	Bomb, block	Agglomerate, or bomb, block tephra	Agglomerate, pyroclastic breccia
2-64 mm	Lapillus	Lapilli, or lapilli tephra	Lapilli tuff
1/16-2 mm	Coarse ash grain	Coarse ash	Coarse (ash) tuff
<1/16 mm	Fine ash grain (dust grain)	Fine ash (dust)	Fine (ash) tuff (dust tuff)

Use combined terms for poorly sorted deposits and rocks: ash-lapilli tuff (lapilli > ash), etc.



MEASUREMENT CONVERSIONS

IF YOU KNOW	MULTIPLY BY	TO FIND
LENGTH		
inches	2.540	centimeters
feet	30.480	centimeters
yards	0.914	meters
miles	1.609	kilometers
millimeters	0.039	inches
centimeters	0.393	inches
meters	3.280	feet
meters	1.093	yards
kilometers	0.621	miles
WEIGHT		
ounces	28.350	grams
pounds	0.453	kilograms
grams	0.035	ounces
kilograms	2.204	pounds
VOLUME		
fluid ounces	29.573	milliliters
pints	0.473	liters
quarts	0.946	liters
gallons (U.S.)	3.785	liters
milliliters	0.033	fluid ounces
cubic inches	0.01639	liters
cubic inches	0.0043	gallons

TEMPERATURE

°C = (°F - 32) x .555 °F = 1.80(°K - 273.15) + 32
°F = (°C x 1.8) + 32 °K = °C + 273.15
°C = °K - 273.15 °K = 0.555 (°F + 273.15) - 32

Inches	Decimals of foot	Millimeters
1/16	.0052	1.5875
1/8	.0104	3.1750
3/16	.0156	4.7625
1/4	.0208	6.3500
5/16	.0260	7.9350
3/8	.0313	9.5250
1/2	.0417	12.700
5/8	.0521	15.875
3/4	.0625	19.050
7/8	.0729	22.225
1"	.0833	25.400
2"	.1667	50.800
3"	.2500	76.200
4"	.3333	101.60
5"	.4167	127.00
6"	.5000	152.40
7"	.5833	177.80
8"	.6667	203.20
9"	.7500	228.60
10"	.8333	254.00
11"	.9167	279.40
1 foot	1.0000	304.80

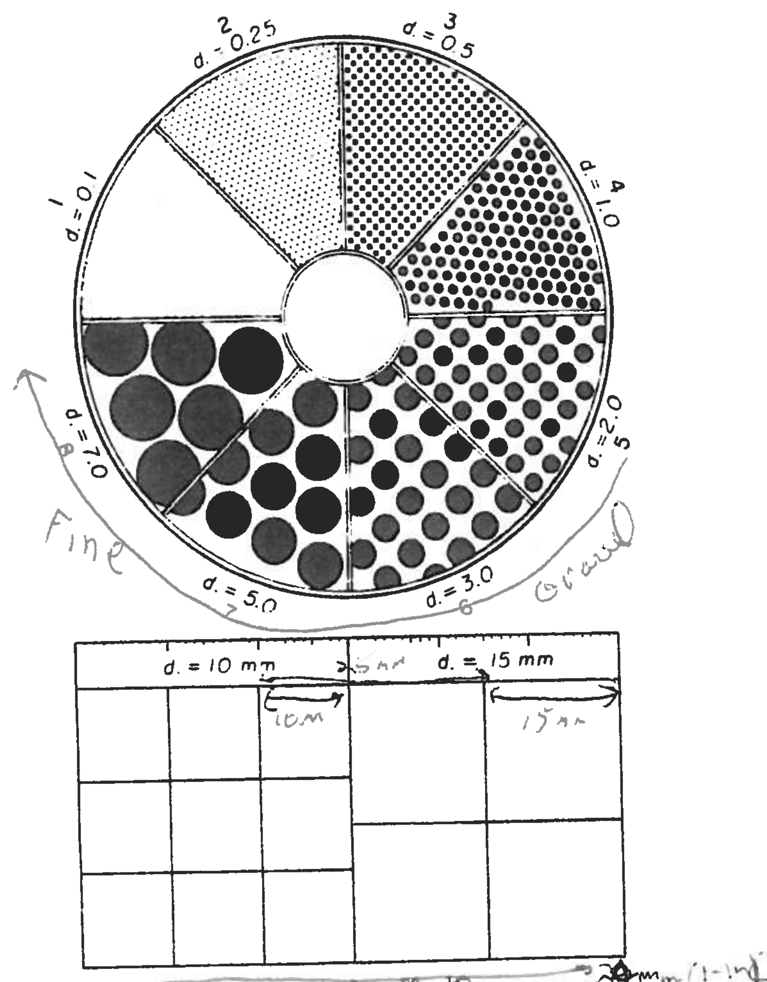
Grain-size Scales

By Roy L. Ingram, University of North Carolina. Modified Wentworth scale. V28, p.936-938. Copyrighted by The American Geophysical Union.

mm	inches	phi	mm	GRADE NAME			U.S. Standard Sieve Series
4096	161.3	−12					
				very large			
2048	80.6	−11					
				large			
1024	40.3	−10			Boulders		
				medium			
512	20.2	−9					
				small			
256	10.1	−8					
				large			
128	5.0	−7			Cobbles		
				small		GRAVEL	
64	2.52	−6					63 mm
				very coarse			
32	1.26	−5					31.5 mm
				coarse			
16	0.63	−4					16 mm
				medium	Pebbles		
8	0.32	−3					8 mm
				fine			
4	0.16	−2					No. 5
				very fine			
2	0.08	−1					No. 10
				very coarse			
1	0.04	0					No. 18
				coarse			
1/2		+1	0.500				No. 35
				medium	Sand	SAND	
1/4		+2	0.250				No. 60
				fine			
1/8		+3	0.125				No. 120
				very fine			
1/16		+4	0.062				No. 230
				coarse			
1/32		+5	0.031				
				medium			
1/64		+6	0.016		Silt		
				fine			
1/128		+7	0.008				
				very fine		MUD	
1/256		+8	0.004				
				coarse			
1/512		+9	0.002				
				medium			
1/1024		+10	0.001		Clay size		
				fine			
1/2048		+11	0.0005				
				very fine			
1/4096		+12	0.00025				

Graph for Determining the Size of Sedimentary Particles
G.V. Chilingar - AAPG Bulletin

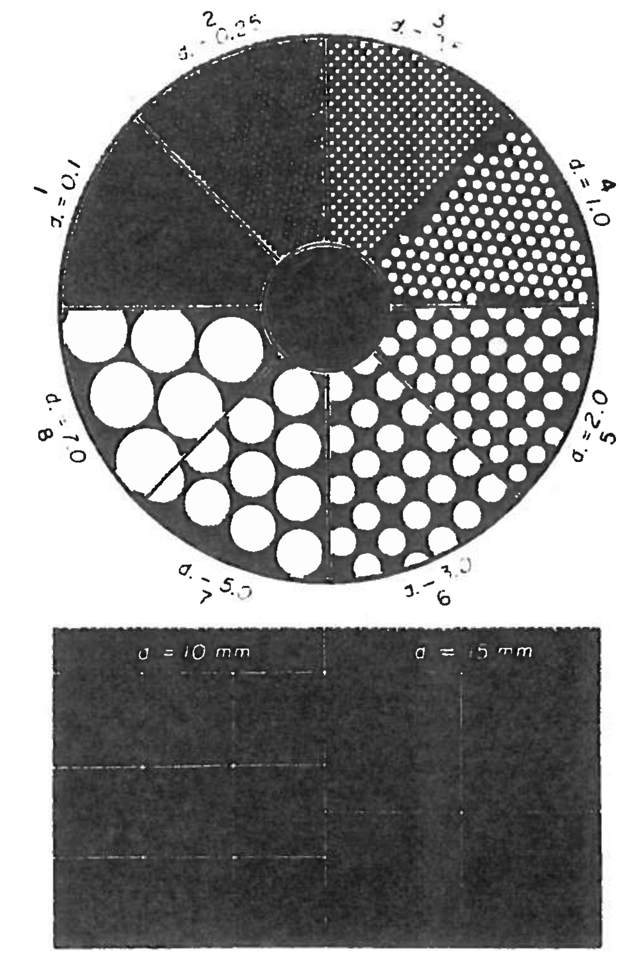
DARK PARTICLES



Place sand grains or rock particles in the central part of the circle. Compare the size of the particles with those on the graph with the aid of a magnifying glass. Record the corresponding number (1, 2, 3, 4, 5, 6, 7, 8) in notebook. For samples with particles of varying sizes, record the most common size first.

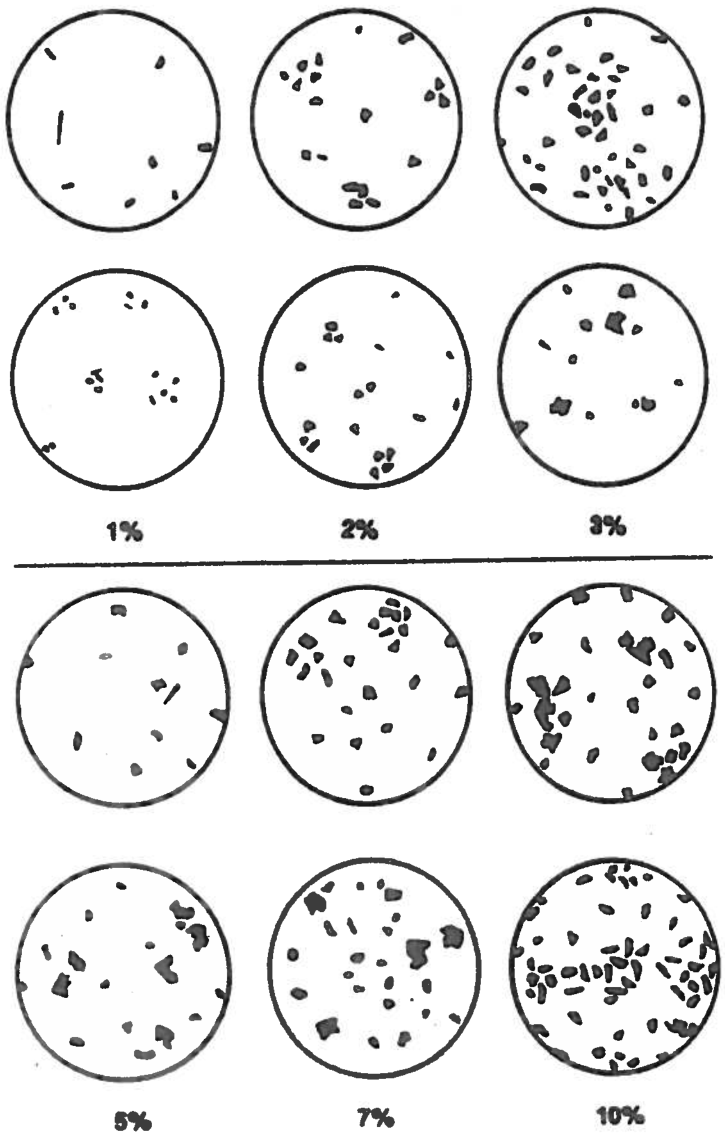
Graph for Determining the Size of Sedimentary Particles
G.V. Chilingar - AAPG Bulletin

LIGHT PARTICLES

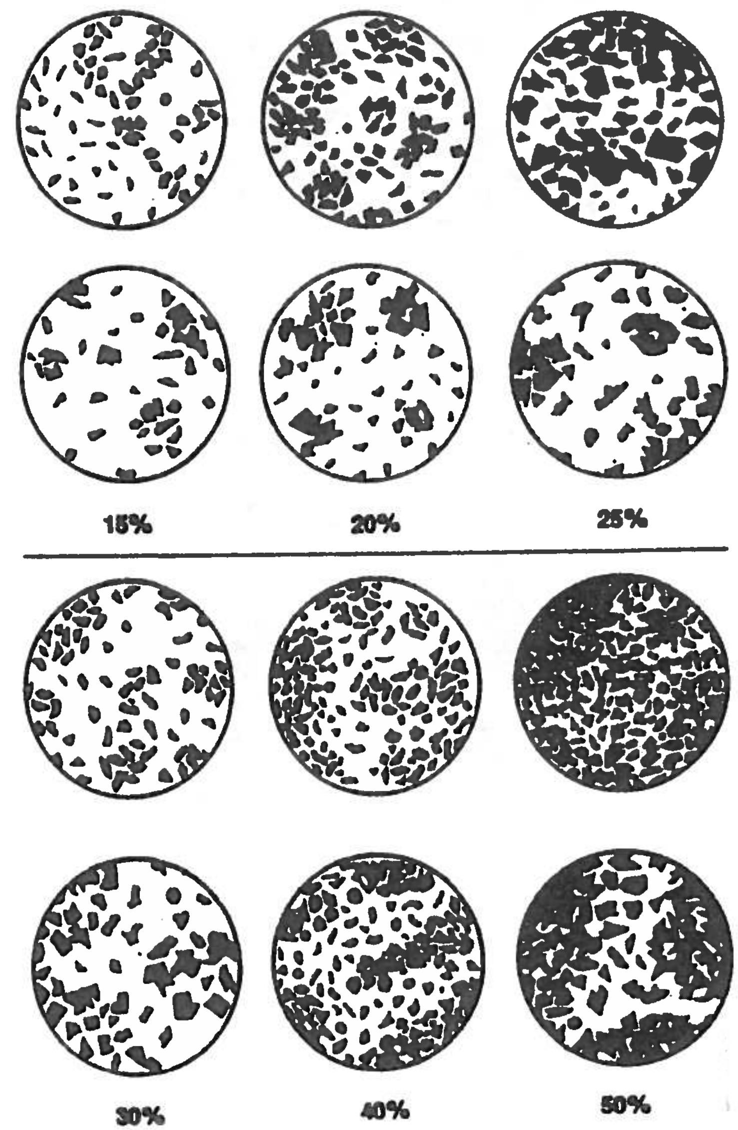


Comparison Chart for Estimating Percentage Composition

Reprinted from *Journal of Sedimentary Petography*, V. 25, N. 2, p. 229-234. Sept. 1955



Comparison Chart for Estimating Percentage Composition



Soil Classification

Coarse grained Soils More than half of material is larger than No 200 sieve	Gravel More than half of coarse fraction is larger than No. 4 sieve size	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly-graded gravels, gravel sand mixtures, little or no fines
		Gravels with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands More than half of coarse fraction is smaller than No. 4 sieve size	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines.
			SP	Poorly graded sands, gravelly sands, little or no fines.
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures.
			SC	Clayey sands, sand-clay mixtures
Fine-grained Soils More than half of material is smaller than No 200 sieve	Silts and Clays Liquid limit less than 50		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
	Highly Organic		Pt	Peat and other highly organic soils

Soil Classification

	mm	inches	Sieve Sizes
Boulders	>300	>11.8	-
Cobbles	75-300	2.9-11.8	-
Coarse Gravel	75-19	2.9-.75	-
Fine Gravel	19-4.8	.75-.19	3/4" - No. 4
Coarse Sand	4.8-2.0	.19-.08	No. 4 - No. 10
Medium Sand	2.0-.43	.08-.02	No. 10 - No. 40
Fine Sand	.43-.08	.02-.003	No. 40 - No. 200
Fine silt & clay	< .08	< .003	< No. 200

Clay

Clay Consistency	Thumb Penetration	SPT, N Blows/Ft.	Undrained shear strength c (PSF) Torvane	Unconfined Compressive Strength q Pocket Penetrometer
Very Soft	Penetrated several inches by thumb Escapes between thumb and fingers when squeezed in hand.	<2	250	500
Soft	Penetrated one inch by thumb. Molded by light finger pressure.	2-4	250-500	500-1000
Medium Soft	Penetrated over 1/4" by thumb with moderate effort. Molded by strong finger pressure.	4-8	500-1000	1000-2000
Stiff	Indented 1/4" with thumb, but only penetrated with great effort.	8-15	1000-2000	2000-4000
Very Stiff	Readily indented by thumbnail.	15-30	2000-4000	4000-8000
Hard	Indented only with difficulty, by thumbnail.	>30	>4000	>8000

Sand

Soil Type	SPT N Blows/Ft.	Relative Density%	Field Test
Very Loose Sand	4	0-15	Easily Penetrated with 1/2" rod pushed by hand.
Loose Sand	4-10	15-35	Easily penetrated with 1/2" rod pushed by hand.
Med. Dense Sand	10-30	35-65	Penetrated a foot with 1/2" rod driven with 5lb hammer.
Dense Sand	30-50	65-85	Penetrated a foot with 1/2" rod driven with a 5lb hammer.
Very Dense Sand	50	85-100	Penetrated inches with a 1/2" rod driven by 5lb hammer.

ATTACHMENT 3

11.0 STANDARD ABBREVIATIONS FOR LITHOLOGIC DESCRIPTIONS

Note: Abbreviations for nouns always begin with a capital letter.

WORD	ABBREVIATION
about	abt
above	ab
absent	abs
abundant	abd
acicular	acic
agglomerate	Aglm
aggregate	Agg
algae, algal	Alg, alg
allochem	Allo
altered	alt
alternating	altg
ammonite	Amm
amorphous	amor
amount	Amt
and	&
angular	ang
anhedral	ahd
anhydrite (-ic)	Anhy, anhy
anthracite	Anthr
aphanitic	aph
appears	ap
approximate	apprx
aragonite	Arag
arenaceous	aren
argillaceous	arg
arkose (-ic)	Ark, ark
as above	a.a.
asphalt (ic)	Asph, asph
assemblage	Assem
associated	assoc
at	@
authigenic	authg
average	Av, av
band (-ed)	Bnd, bnd
basalt (-ic)	Bas, bas
basement	Bm
become (-ing)	bcm
bed (-ed)	Bd, bd
bedding	Bdg
bentonite (-ic)	Bent, bent
bitumen (-inous)	Bit, bit
bioclastic	biocl
bioherm (-al)	Bioh, bioh
biomicrite	Biomi
biosparite	Biosp
biostrom (-al)	Biost, biost
biotite	Biot
birdseye	Bdeye
black (-ish)	blk, blksh
blade (-ed)	Bld, bld
blocky	blky
blue (-ish)	bl, blsh
bored (-ing)	Bor, bor
bottom	Btm
botryoid (-al)	Bot, bot
boulder	Bld
boundstone	Bdst
brachiopod	Brach
brackish	brak
branching	brhg
break	Brk, brk
breccia (-ted)	Brec, brec
bright	brt
brittle	brit
brown	brn
bryozoa	Bry
bubble	Bubl
buff	bu
burrow (-ed)	Bur, bur
calcarenite	Clcar
calcilutite	Clclt
calcirudite	Clcrd
calcisiltite	Clslt
calcisphere	Clcsp
calcite (-ic)	Calc, calctc
calcareous	calc
caliche	cche
carbonaceous	carb
carbonized	cb
cavern (-ous)	Cav, cav
caving	Cvg
cement (-ed, -ing)	Cmt, cmt
cephalopod	Ceph
chalcedony (-ic)	Chal, chal
chalk (-y)	Chk, chky
charophyte	Char
chert (-y)	Cht, cht
chitin (-ous)	Chit, chit
chlorite (-ic)	Chlor, chlor
chocolate	choc
circulate (-ion)	circ, Circ
clastic	clas

WORD	ABBREVIATION
clay (-ey)	Cl, cl
claystone	Clst
clean	cln
clear	clr
cleavage	Clvg
cluster	Clus
coal	C
coarse	crs
coated (-ing)	cotd,cotg,Cotg
coated grains	cotd gn
cobble	Cbl
color (-ed)	Col, col
common	com
compact	cpct
compare	cf
concentric	cncn
conchoidal	conch
concretion (-ary)	Conc, conc
conglomerate (-ic)	Cgl, cgl
conodont	Cono
considerable	cons
consolidated	consol
conspicuous	conspic
contact	Ctc
contamination (-ed)	Contam, contam
content	Cont
contorted	cntrt
coquina (-oid)	Coq, coqid
coral, coralline	Cor, corln
core	c, ¢
covered	cov
cream	crm
crenulated	cren
crinkled	crnk
crinoid (-al)	Crin, crinal
cross	x
cross-bedded	x-bd
cross-laminated	x-lam
cross-stratified	x-strat
crumpled	crpld
crystocrystalline	crpxln
crystal (-line)	Xl, xln
cube, cubic	Cub, cub
cuttings	Ctgs
dark (-er)	dk, dkr
dead	dd
debris	Deb
decrease (-ing)	Decr, decr
dense	dns
depauperate	depau
description	Descr
detrital	detr
devitrified	devit
diabase	Db
diagenesis (-etic)	Diagn, diagn
diameter	Dia
disseminated	dissem
distillate	Dist
ditto	" or do
dolomite (-ic)	Dol, dol
dominant (-ly)	dom
drilling	drlg
drill stem test	DST
drusy	dru
earthy	ea
east	E
echinoid	Ech
elevation	Elev
elongate	elong
embedded	embd
equant	eqnt
equivalent	Equiv
euhedral	euhd
euxinic	eux
evaporite (-itic)	Evap, evap
excellent	ex
exposed	exp
extraclast (-ic)	Exclas, exclas
extremely	extr
extrusive rock, extrusive	Exv, exv
facet (-ed)	Fac, fac
faint	fnt
fair	fr
fault (-ed)	Flt, flt
fauna	Fau
feet	Ft
feldspar (-athic)	Fspr, fspr
fenestra (-al)	Fen, fen
ferruginous	ferr
fibrous	fibr
fine (-ly)	f, fnly
fissile	fis
flaggy	flg
flake, flaky	Flk, flk
flat	fl
floating	fltg
flora	Flo
fluorescence (-ent)	Fluor, fluor
foliated	fol
foot	Ft
foraminifer,foraminiferal	Foram, foram

WORD	ABBREVIATION
formation	Fm
fossil (-iferous)	Foss, foss
fracture (-d)	Frac, frac
fragment (-al)	Frag, frag
frequent	freq
fresh	frs
friable	fri
fringe (-ing)	Frg, frg
frosted	fros
frosted quartz grains	F.Q.G.
fucoid (-al)	Fuc, fuc
fusulinid	Fus
gabbro	Gab
gastropod	Gast
gas	G
generally	gen
geopetal	gept
gilsonite	Gil
glass (-y)	Glas, glas
glauconite (-itic)	Glauc, glauc
Globigerina (-inal)	Glob, glob
gloss (-y)	Glos, glos
gneiss (-ic)	Gns, gns
good	gd
grading	grad
grain (-s, -ed)	Gr, gr
grainstone	Grst
granite	Grt
granite wash	G.W.
granule (-ar)	Gran, gran
grapestone	grapst
graptolite	Grap
gravel	Grv
gray, grey (-ish)	gry, grysh
graywacke	Gwke
greasy	gsy
green (-ish)	gn, gnsh
grit (-ty)	Gt, gt
gypsum (-iferous)	Gyp, gyp
hackly	hkl
halite (-iferous)	Hal, hal
hard	hd
heavy	hvy
hematite (-ic)	Hem, hem
Heterostegina	Het
heterogeneous	hetr
high (-ly)	hi
homogeneous	hom
horizontal	hor
hydrocarbon	Hydc
igneous rock (igneous)	Ig, ig
impression	Imp
inch	In
inclusion (-ded)	Incl, incl
increasing	incr
indistinct	indst
indurated	ind
Inoceramus	Inoc
in part	I.P.
insoluble	insl
interbedded	intbd
intercalated	intercal
intercrystalline	intxln
intergranular	intgran
intergrown	intgn
interlaminated	intrlam
interparticle	intpar
intersticies (-itial)	Intst, intst
interval	Intvl
intraclast (-ic)	Intclas, intclas
intraparticle	intrapar
intrusive rock, intrusive	Intr, intr
invertebrate	Invtb
iridescent	irid
ironstone	Fe-st
irregular (-ly)	irr
isopachous	iso
jasper	Jasp
joint (-ed, -ing)	Jt, jt
kaolin (-itic)	Kao, kao
lacustrine	lac
lamina (-tions, -ated)	Lam, lam
large	lge
laterite (-itic)	Lat, lat
lavender	lav
layer	Lyr
leached	lchd
lens, lenticular	Len, lent
light	lt
lignite (-itic)	Lig, lig
limestone	Ls
limonite (itic)	Lim, lim
limy	lmy
lithic	lit
lithographic	lithgr
lithology (-ic)	Lith, lith
little	Ltl
littoral	litt

WORD	ABBREVIATION
local	loc
long	lg
loose	lse
lower	l
lustre	Lstr
lutite	Lut
macrofossil	Macrofos
magnetite, magnetic	Mag, mag
manganese, manganiferous	Mn, mn
marble	Mbl
marl (-y)	Mrl, mrl
marlstone	Mrlst
marine	marn
maroon	mar
massive	mass
material	Mat
matrix	Mtrx
maximum	max
medium	m or med.
member	Mbr
meniscus	men
metamorphic rock,	Meta
metamorphic (-osed)	meta, metaph
mica (-ceous)	Mic, mic
micrite (-ic)	Micr, micr
microcrystalline	microxln
microfossil (-iferous)	Microfos, microfos
micrograined	micgr
micro-oolite	Microol
micropore (-osity)	Micropor, micropor
microspar	Microspr
microstylolite	Microstyl
middle	Mid
miliolid	Milid
milky	mky
mineral (-ized)	Min, min
minor	mnr
moderate	mod
mold (-ic)	Mol, mol
mollusc	Moll
mosaic	mos
mottled	mott
mud (-dy)	md, mdy
mudstone	Mdst
muscovite	Musc
nacreous	nac
nodules (-ar)	Nod, nod
north	N
no sample	n.s.
no show	n/s
novaculite	Novac
no visible porosity	n.v.p.
numerous	num
occasional	occ
ochre	och
oil	O
oil source rock	OSR
olive	olv
ooid (-al)	Oo, oo
oolicast (-ic)	Ooc, ooc
oolite (-itic)	Ool, ool
oomold (-ic)	Oomol, oomol
oncolite (-oidal)	Onc, onc
opaque	op
orange (-ish)	or, orsh
Orbitolina	*Orbit*
organic	org
orthoclase	Orth
orthoquartzite	O-Qtz
ostracod	Ostr
overgrowth	ovgth
oxidized	ox
oyster	Oyst
packstone	Pkst
paper (-y)	Pap, pap
part (-ly)	Pt, pt
particle	Par, par
parting	Ptg
parts per million	PPM
patch (-y)	Pch, pch
pebble (-ly)	Pbl, pbl
pelecypod	Pelec
pellet (-al)	Pel, pel
pelletoid (-al)	Peld, peld
permeability (-able)	Perm, k, perm
pendular (-ous)	Pend, pend
petroleum, petroliferous	Pet, pet
phlogopite	Phlog
phosphate (-atic)	Phos, phos
phyllite, phyllitic	Phyl, phyl
phreatic	phr
pink	pk
pinkish	pkish
pin-point (porosity)	p.p.
pisoid (-al)	Piso, piso
pisolite, pisolitic	Pisol, pisol
pitted	pit
plagioclase	Plag
plant	Plt
plastic	plas

WORD	ABBREVIATION	WORD	ABBREVIATION
platy	plty	sand (-y)	Sd, sdy
polish, polished	Pol, pol	sandstone	Sst
pollen	Poln	saturation (-ated)	Sat, sat
polygonal	poly	scarce	scs
porcelaneous	porcel	scattered	scat
porosity, porous	Por, ϕ, por	schist (-ose)	Sch, sch
possible (-ly)	poss	scolecodont	Scol
predominant (-ly)	pred	secondary	sec
preserved	pres	sediment (-ary)	Sed, sed
primary	prim	selenite	Sel
probable (-ly)	prob	shale (-ly)	Sh, sh
production	Prod	shell	Shl
prominent	prom	shelter porosity	Shlt por
pseudo-	ps	show	Shw
pseudo oolite (-ic)	Psool, psool	siderite (-itic)	Sid, sid
pumice-stone	Pst	sidewall core	S.W.C.
purple	purp	silica (-iceous)	Sil, sil
pyrite (-itized, -itic)	Pyr, pyr	silky	slky
pyrobitumen	Pybit	silt (-y)	Slt, slty
pyroclastic	pyrcl	siltstone	Sltst
		similar	sim
quartz (-ose)	Qtz, qtz	skeletal	skel
quartzite (-ic)	Qtzt, qtzt	slabby	slb
		slate (-y)	Sl, sl
radial (-ating)	Rad, rad	slickenside (-d)	Slick, slick
radiaxial	Radax	slight (-ly)	sli, slily
range	rng	small	sml
rare	r	smooth	sm
recemented	recem	soft	sft
recovery (-ered)	Rec, rec	solution, soluble	Sol, sol
recrystallized	rexlzd	somewhat	smwt
red (-ish)	rd, rdsh	sorted (-ing)	srt, srtg
reef (-oid)	Rf, rf	south	S
remains	Rem	spar (-ry)	Spr, spr
replaced (-ment)	rep, Repl	sparse (-ly)	sps, spsly
residue (-ual)	Res, res	speck (-led)	Spk, spkld
resinous	rsns	sphalerite	Sphal
rhomb (-ic)	Rhb, rhb	spherule (-itic)	Spher, spher
ripple	Rpl	spicule (-ar)	Spic, spic
rock	Rk	splintery	Splin
round (-ed)	rnd, rndd	sponge	Spg
rounded, frosted, pitted	r.f.p.	spore	Spo
rubble (-bly)	Rbl, rbl	spotted (-y)	sptd, spty
rudist	Rud	stain (-ed, -ing)	Stn, stn
		stalactitic	stal
		strata (-ified)	Strat, strat
saccharoidal	sacc	streak (-ed)	Strk, strk
salt (-y)	Sa, sa	striae (-ted)	Stri, stri
salt and pepper	s & p	stringer	strgr
salt water	S.W.	stromatolite (-itic)	Stromlt, stromlt
same as above	a.a.	stromatoporoid	Strom
sample	Spl	structure	Str

WORD	ABBREVIATION
stylolite (-itic)	Styl, styl
subangular	sbang
sublithic	sblit
subrounded	sbrndd
sucrosic	suc
sulphur, sulphurous	Su, su
superficial oolite (-ic)	Spfool, spfool
surface	Surf
syntaxial	syn
tabular (-ate)	tab
tan	tn
terriginous	ter
texture (-d)	Tex, tex
thick	thk
thin	thn
thin-bedded	t.b.
thin section	T.S.
throughout	thru
tight	ti
top	Tp
tough	tgh
trace	Tr
translucent	trnsl
transparent	trnsp
trilobite	Tril
tripoli (-itic)	Trip, trip
tube (-ular)	Tub, tub
tuff (-aceous)	Tf, tf
type (-ical)	Typ, typ
unconformity	Unconf
unconsolidated	uncons
underclay	Uc
underlying	undly
uniform	uni
upper	u
vadose	Vad, vad
variation (able)	Var, var
variegated	vgt
varicolored	varic
varved	vrvd
vein (-ing, -ed)	Vn, vn
veinlet	Vnlet
vermillon	verm
vertebrate	vrtb
vertical	vert
very	v
very poor sample	V.P.S.
vesicular	ves
violet	vi

WORD	ABBREVIATION
visible	vis
vitreous (-ified)	vit
volatile	volat
volcanic rock, volcanic	Volc, volc
vug (-gy)	Vug, vug
wackestone	Wkst
washed residue	W.R.
water	Wtr
wavy	wvy
waxy	wxy
weak	wk
weathered	wthd
well	Wl, wl
west	W
white	wh
with	w/
without	w/o
wood	Wd
yellow (ish)	yel, yelsh
zircon	Zr
zone	Zn

ATTACHMENT C

USEPA Region 4-SOP

Field Equipment Cleaning and Decontamination,

SESDPROC-205-R1, Nov. 2007

Region 4
U.S. Environmental Protection Agency
Science and Ecosystem Support Division
Athens, Georgia

OPERATING PROCEDURE

Title: **Field Equipment Cleaning and Decontamination**	
Effective Date: November 1, 2007	**Number:** SESDPROC-205-R1

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Field Quality Manager.

History	Effective Date
SESDPROC-205-R1, *Field Equipment Cleaning and Decontamination*, replaces SESDPROC-205-R0. **General** Corrected any typographical, grammatical and/or editorial errors. **Title Page** Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. Changed Bill Cosgrove's title from Acting Chief to Chief. **Section 1.3** Updated information to reflect that the procedure is located on the H: drive of the LAN. Clarified Field Quality Manager (FQM) responsibilities. **Section 1.5** Alphabetized and revised the referencing style for consistency. **Section 1.6.1** Corrected the title of the Safety, Health, and Environmental Management Program Procedures and Policy Manual.	November 1, 2007
SESDPROC-205-R0, *Field Equipment Cleaning and Decontamination*, Original Issue	February 05, 2007

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Contents

1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when cleaning and decontaminating sampling equipment during the course of field investigations.

1.2 Scope/Application

The procedures contained in this document are to be followed when field cleaning sampling equipment, for both re-use in the field, as well as used equipment being returned to the Field Equipment Center (FEC). On the occasion that SESD field investigators determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that other procedures must be used to clean or decontaminate sampling equipment at a particular site, the variant procedure will be documented in the field log book, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager (FQM) is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 Definitions

Decontamination: The process of cleaning dirty sampling equipment to the degree to which it can be re-used, with appropriate QA/QC, in the field.

Field Cleaning: The process of cleaning dirty sampling equipment such that it can be returned to the FEC in a condition that will minimize the risk of transfer of contaminants from a site.

De-ionized water: Tap water that has been treated by passing through a standard de-ionizing resin column. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard inductively coupled Argon Plasma Spectrophotometer (ICP) (or equivalent) scan. De-ionized water obtained by other methods is acceptable, as long as it meets the above analytical criteria. Organic-free water may be substituted for de-ionized water.

Organic-free water: Tap water that has been treated with activated carbon and de-ionizing units. At a minimum, the finished water must meet the analytical criteria of de-ionized water and it should contain no detectable pesticides, herbicides, or extractable organic compounds, and no volatile organic compounds above minimum detectable levels as determined by the Region 4 laboratory for a given set of analyses. Organic-free water obtained by other methods is acceptable, as long as it meets the above analytical criteria.

Soap: A standard brand of phosphate-free laboratory detergent, such as Luminox®.

Tap water: Water from any potable water supply. De-ionized water or organic-free water may be substituted for tap water.

Drilling Equipment: All power equipment used to collect surface and sub-surface soil samples or install wells. For purposes of this procedure, direct push is also included in this definition.

1.5 References

SESD Operating Procedure for Management of Investigation Derived Waste, SESDPROC-202, Most Recent Version

SESD Operating Procedure for Equipment Cleaning and Decontamination at the FEC, SESDPROC-206, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.6 General Precautions

1.6.1 Safety

Proper safety precautions must be observed when field cleaning or decontaminating dirty sampling equipment. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASPs) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate. At a minimum, the following precautions should be taken in the field during these cleaning operations:

- When conducting field cleaning or decontamination using laboratory detergent, safety glasses with splash shields or goggles, and latex gloves will be worn.

- No eating, smoking, drinking, chewing, or any hand to mouth contact should be permitted during cleaning operations.

1.6.2 Procedural Precaution

Prior to mobilization to a site, the expected types of contamination should be evaluated to determine if the field cleaning and decontamination activities will generate rinsates and other waste waters that might be considered RCRA hazardous waste or may require special handling.

2 Introduction to Field Equipment Cleaning and Decontamination

2.1 General

The procedures outlined in this document are intended for use by field investigators for cleaning and decontaminating sampling and other equipment in the field. These procedures should be followed in order that equipment is returned to the FEC in a condition that will minimize the risk of transfer of contaminants from a site.

Sampling and field equipment cleaned in accordance with these procedures must meet the minimum requirements for the Data Quality Objectives (DQOs) of the study or investigation. Site-specific alterations to these procedures should be documented in the study plan. Deviations from these procedures should be documented in the field records.

Cleaning procedures for use at the Field Equipment Center (FEC) are found in SESD Operating Procedure for Equipment Cleaning and Decontamination at the FEC (SESDPROC-206).

2.2 Handling and Containers for Cleaning Solutions

Improperly handled cleaning solutions may easily become contaminated. Storage and application containers must be constructed of the proper materials to ensure their integrity. Following are acceptable materials used for containing the specified cleaning solutions:

- Soap must be kept in clean plastic, metal, or glass containers until used. It should be poured directly from the container during use.

- Tap water may be kept in tanks, hand pressure sprayers, squeeze bottles, or applied directly from a hose.

- De-ionized water must be stored in clean, glass or plastic containers that can be closed prior to use. It can be applied from plastic squeeze bottles.

- Organic-free water must be stored in clean glass or Teflon® containers prior to use. It may be applied using Teflon® squeeze bottles, or with the portable system.

2.3 Disposal of Cleaning Solutions

Procedures for the safe handling and disposition of investigation derived waste (IDW); including used wash water and rinse water are in SESD Operating Procedure for Management of Investigation Derived Waste (SESDPROC-202).

2.4 Sample Collection Equipment Contaminated with Concentrated Materials

Equipment used to collect samples of concentrated materials from investigation sites must be field cleaned before returning from the study. At a minimum, this should consist of washing with soap and rinsing with tap water. When the above procedure cannot be followed, the following options are acceptable:

1. Leave with facility for proper disposal;

2. If possible, containerize, seal and secure the equipment and leave on-site for later disposal;

3. Containerize, bag or seal the equipment so that no odor is detected and return to the SESD.

It is the project leader's responsibility to evaluate the nature of the sampled material and determine the most appropriate cleaning procedures for the equipment used to sample that material.

2.5 Sample Collection Equipment Contaminated with Environmental Media

Equipment used to collect samples of environmental media from investigation sites should be field cleaned before returning from the study. Based on the condition of the sampling equipment, one or more of the following options must be used for field cleaning:

1. Wipe the equipment clean;

2. Water-rinse the equipment;

3. Wash the equipment in detergent and water followed by a tap water rinse.

4. For grossly contaminated equipment, the procedures set forth in Section 2.4 must be followed.

Under extenuating circumstances such as facility limitations, regulatory limitations, or during residential sampling investigations where field cleaning operations are not feasible, equipment can be containerized, bagged or sealed so that no odor is detected and returned to the FEC without being field cleaned. If possible, FEC personnel should be notified that equipment will be returned without being field cleaned. It is the project leader's responsibility to evaluate the nature of the sampled material and determine the most appropriate cleaning procedures for the equipment used to sample that material.

2.6 Handling of Decontaminated Equipment

After decontamination, equipment should be handled only by personnel wearing clean gloves to prevent re-contamination. In addition, the equipment should be moved away (preferably upwind) from the decontamination area to prevent re-contamination. If the equipment is not to be immediately re-used it should be covered with plastic sheeting or wrapped in aluminum foil to prevent re-contamination. The area where the equipment is kept prior to re-use must be free of contaminants.

3 Field Equipment Decontamination Procedures

3.1 General

Sufficient equipment should be transported to the field so that an entire study can be conducted without the need for decontamination. When equipment must be decontaminated in the field, the following procedures are to be utilized.

3.2 Specifications for Decontamination Pads

Decontamination pads constructed for field cleaning of sampling and drilling equipment should meet the following minimum specifications:

- The pad should be constructed in an area known or believed to be free of surface contamination.

- The pad should not leak.

- If possible, the pad should be constructed on a level, paved surface and should facilitate the removal of wastewater. This may be accomplished by either constructing the pad with one corner lower than the rest, or by creating a sump or pit in one corner or along one side. Any sump or pit should also be lined.

- Sawhorses or racks constructed to hold equipment while being cleaned should be high enough above ground to prevent equipment from being splashed.

- Water should be removed from the decontamination pad frequently.

- A temporary pad should be lined with a water impermeable material with no seams within the pad. This material should be either easily replaced (disposable) or repairable.

At the completion of site activities, the decontamination pad should be deactivated. The pit or sump should be backfilled with the appropriate material designated by the site project leader, but only after all waste/rinse water has been pumped into containers for disposal. See SESD Operating Procedure for Management of Investigation Derived Waste (SESDPROC-202) for proper handling and disposal of these materials. If the decontamination pad has leaked excessively, soil sampling may be required.

3.3 "Classical Parameter" Sampling Equipment

"Classical Parameters" are analyses such as oxygen demand, nutrients, certain inorganics, sulfide, flow measurements, etc. For routine operations involving classical parameter analyses, water quality sampling equipment such as Kemmerers, buckets, dissolved oxygen dunkers, dredges, etc., may be cleaned with the sample water or tap water between sampling locations as appropriate.

Flow measuring equipment such as weirs, staff gages, velocity meters, and other stream gauging equipment may be cleaned with tap water between measuring locations, if necessary.

Note: The procedures described in Section 3.3 are not to be used for cleaning field equipment to be used for the collection of samples undergoing trace organic or inorganic constituent analyses.

3.4 Sampling Equipment used for the Collection of Trace Organic and Inorganic Compounds

For samples undergoing trace organic or inorganic constituent analyses, the following procedures are to be used for all sampling equipment or components of equipment that come in contact with the sample:

1. Clean with tap water and Luminox® soap using a brush, if necessary, to remove particulate matter and surface films. Equipment may be steam cleaned (Luminox® soap and high pressure hot water) as an alternative to brushing. Sampling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. PVC or plastic items should not be steam cleaned.

2. Rinse thoroughly with tap water.

3. Rinse thoroughly with organic-free water and place on a clean foil-wrapped surface to air-dry.

4. All equipment must be wrapped with foil. If the equipment is to be stored overnight before it is wrapped in foil, it should be covered and secured with clean, unused plastic sheeting.

3.5 Well Sounders or Tapes

The following procedures are recommended for decontaminating well sounders (water level indicators) and tapes:

1. Wash with soap and tap water.

2. Rinse with tap water.

3. Rinse with de-ionized water.

3.6 Redi-Flo2® Pump

The Redi-Flo2® pump should be decontaminated prior to use and between each monitoring well. The following procedure is required:

CAUTION - Make sure the pump is not plugged in.

1. Using a brush, scrub the exterior of the pump, electrical cord and garden hose with soap and tap water. Do not wet the electrical plug.

2. Rinse with tap water.

3. Rinse with de-ionized water.

4. Place the equipment in a clean plastic bag.

To clean the Redi-Flo2® ball check valve:

1. Remove the ball check valve from the pump head. Check for wear and/or corrosion, and replace as needed.

2. Using a brush, scrub all components with soap and tap water.

3. Rinse with de-ionized water.

4. Replace the ball check valve to the Redi-Flo2® pump head.

3.7 Downhole Drilling Equipment

These procedures are to be used for drilling activities involving the collection of soil samples for trace organic and inorganic constituent analyses and for the construction of monitoring wells to be used for the collection of groundwater samples for trace organic and inorganic constituent analyses.

3.7.1 Introduction

Cleaning and decontamination of all equipment should occur at a designated area (decontamination pad) on the site. The decontamination pad should meet the specifications of Section 3.2 of this procedure.

Tap water brought on the site for drilling and cleaning purposes should be contained in a pre-cleaned tank.

A steam cleaner and/or high pressure hot water washer capable of generating a pressure of at least 2500 PSI and producing hot water and/or steam (200^{o} F plus), with a soap compartment, should be obtained.

3.7.2 Preliminary Cleaning and Inspection

Drilling equipment should be clean of any contaminants that may have been transported from off-site to minimize the potential for cross-contamination. The drilling equipment should not serve as a source of contaminants. Associated drilling and decontamination equipment, well construction materials, and equipment handling procedures should meet these minimum specified criteria:

- All downhole augering, drilling, and sampling equipment should be sandblasted before use if painted, and/or there is a buildup of rust, hard or caked matter, etc., that cannot be removed by steam cleaning (soap and high pressure hot water), or wire brushing. Sandblasting should be performed <u>prior to arrival</u> on site, or well away from the decontamination pad and areas to be sampled.

- Any portion of the drilling equipment that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high pressure hot water) and wire brushed (as needed) to remove all rust, soil, and other material which may have come from other sites before being brought on site.

- Printing and/or writing on well casing, tremie tubing, etc., should be removed before use. Emery cloth or sand paper can be used to remove the printing and/or writing. Most well material suppliers can provide materials without the printing and/or writing if specified when ordered. Items that cannot be cleaned are not acceptable and should be discarded.

- Equipment associated with the drilling and sampling activities should be inspected to insure that all oils, greases, hydraulic fluids, etc., have been removed, and all seals and gaskets are intact with no fluid leaks.

3.7.3 Drill Rig Field Cleaning Procedure

Any portion of the drill rig, backhoe, etc., that is over the borehole (kelly bar or mast, backhoe buckets, drilling platform, hoist or chain pulldowns, spindles, cathead, etc.) should be steam cleaned (soap and high pressure hot water) between boreholes.

3.7.4 Field Decontamination Procedure for Drilling Equipment

The following is the standard procedure for field cleaning augers, drill stems, rods, tools, and associated equipment. This procedure does <u>not</u> apply to well casings, well screens, or split-spoon samplers used to obtain samples for chemical analyses, which should be decontaminated as outlined in Section 3.4 of this procedure.

1. Wash with tap water and soap, using a brush if necessary, to remove particulate matter and surface films. Steam cleaning (high pressure hot water with soap) may be necessary to remove matter that is difficult to remove with the brush. Drilling equipment that is steam cleaned should be placed on racks or saw horses at least two feet above the floor of the decontamination pad. Hollow-stem augers, drill rods, etc., that are hollow or have holes that transmit water or drilling fluids, should be cleaned on the inside with vigorous brushing.

2. Rinse thoroughly with tap water.

3. Remove from the decontamination pad and cover with clean, unused plastic. If stored overnight, the plastic should be secured to ensure that it stays in place.

ATTACHMENT D

USEPA Region 4-SOP

Management of Investigation Derived Waste

SESDPROC-202-R2, October 2010

Region 4 **U.S. Environmental Protection Agency** **Science and Ecosystem Support Division** **Athens, Georgia**
OPERATING PROCEDURE
Title: **Management of Investigation Derived Waste**

Effective Date: October 15, 2010	**Number:** SESDPROC-202-R2

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Document Control Coordinator.

History	Effective Date
SESDPROC-202-R2, *Management of Investigation Derived Waste*, replaces SESDPROC-202-R1. **General:** Corrected typographical, grammatical and/or editorial errors. **Cover Page:** The Enforcement and Investigations Branch Chief was changed from Antonio Quinones to Archie Lee. The FQM was changed from Laura Ackerman to Liza Montalvo. **Revision History:** Changed Field Quality Manager to Document Control Coordinator. **Section 1.2:** Added the following statement: Mention of trade names or commercial products does not constitute endorsement or recommendation for use. **Section 1.3:** Omitted reference to the H: drive of the LAN. Changed Field Quality Manager to Document Control Coordinator. **Section 2, first bullet:** Replaced "personnel" protective equipment with "personal" protective equipment. **Table 1:** On the <u>Hazardous/PPE-Reusable</u> cell - Added the full reference to SESDPROC-205. On the <u>Non-hazardous/Decontamination Water</u> cell - Added a statement to reflect that decontamination water may also be disposed in a sanitary sewer system, with permission from the wastewater treatment plant representative, and if doing so does not endanger human health or the environment, or violate federal or state regulations. On the <u>Non-hazardous/Disposable Equipment</u> cell - Added a statement to reflect that, if unfeasible, this equipment could be returned to the FEC for disposal in the FEC's dumpster.	October 15, 2010
SESDPROC-202-R1, *Management of Investigation Derived Waste*, replaces SESDPROC-202-R0. **General** Corrected any typographical, grammatical and/or editorial errors. **Title Page** Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch.	November 1, 2007

Changed Bill Cosgrove's title from Acting Chief to Chief. **Section 1.3** Updated information to reflect that the procedure is located on the H: drive of the LAN. Clarified Field Quality Manager (FQM) responsibilities. **Section 1.4** Alphabetized and revised the referencing style for consistency. **Section 1.5.1** Corrected the title of the Safety, Health, and Environmental Management Program Procedures and Policy Manual.	
SESDPROC-202-R0, Management of Investigation Derived Waste, Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

This document describes general and specific procedures and considerations to be used and observed when managing investigation derived waste (IDW) generated during the course of hazardous waste site investigations.

1.2 Scope/Application

The procedures and management options for the different categories of IDW described in this document are to be used by SESD field personnel to manage IDW generated during site investigations. On the occasion that SESD field personnel determine that any of the procedures described in this section are inappropriate, inadequate or impractical and that another procedure must be used to manage IDW generated at a particular site, the variant procedure will be documented in the field logbook, along with a description of the circumstances requiring its use. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD Local Area Network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 References

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

United States Environmental Protection Agency (US EPA). 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when managing IDW. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when managing IDW:

- Due to time limitations and restrictions posed by RCRA regulations on storage of hazardous waste, accumulation start dates should be identified on all drums, buckets or other containers used to hold IDW so that it can be managed in a timely manner.
- During generation of both non-hazardous and hazardous IDW, keep hazardous IDW segregated from non-hazardous IDW to minimize the volume of hazardous IDW that must be properly managed.

2 Types of Investigation Derived Waste

Materials which may become IDW include, but are not limited to:

- Personal protective equipment (PPE) - This includes disposable coveralls, gloves, booties, respirator canisters, splash suits, etc.

- Disposable equipment and items - This includes plastic ground and equipment covers, aluminum foil, conduit pipe, composite liquid waste samplers (COLIWASAs), Teflon® tubing, broken or unused sample containers, sample container boxes, tape, etc.

- Soil cuttings from drilling or hand augering.

- Drilling mud or water used for mud or water rotary drilling.

- Groundwater obtained through well development or well purging.

- Cleaning fluids such as spent solvents and wash water.

- Packing and shipping materials.

Table 1, found at the end of this procedure, lists the types of IDW commonly generated during field investigations and the current disposal practices for these materials.

For the purpose of determining the ultimate disposition of IDW, it is typically distinguished as being either hazardous or non-hazardous. This determination is based on either clear regulatory guidance or by subsequent analysis. This determination and subsequent management is the responsibility of the program site manager.

3 Management of Non-Hazardous IDW

Disposal of non-hazardous IDW should be addressed in the study plan or QAPP for the investigation. To reduce the volume of any IDW transported back to the Field Equipment Center (FEC), it may be necessary to compact the waste into a reusable container, such as a 55-gallon drum.

If the waste is from an active facility, permission should be sought from the operator of the facility to place the non-hazardous PPE, disposable equipment, and/or paper/cardboard into the facility's dumpsters. If necessary, these materials may be placed into municipal dumpsters, with the permission of the owner. These materials may also be taken to a nearby permitted landfill. On larger studies, waste hauling services may be obtained and a dumpster located at the study site.

Disposal of non-hazardous IDW such as drill cuttings, drilling mud, purge or development water, decontamination wash water, etc., should be specified in the approved study plan or QAPP. It is recommended that these materials be placed into a unit with an environmental permit, such as a landfill or sanitary sewer. These materials must not be placed into dumpsters. If the facility at which the study is being conducted is active, permission should be sought to place these types of IDW into the facility's treatment system. It may be feasible to spread drill cuttings around the borehole, or, if the well is temporary, to place the cuttings back into the borehole. Non-hazardous monitoring well purge or development water may also be poured onto the ground down gradient of the monitoring well when site conditions permit. Purge water from private potable wells which are in service may be discharged directly onto the ground surface.

The minimum requirements for this subsection are:

- Non-hazardous liquid and soil/sediment IDW may be placed on the ground or returned to the source if doing so does not endanger human health or the environment or violate federal or state regulations. Under no circumstances, however, should monitoring well purge water be placed back into the well from which it came.
- Soap and water decontamination fluids and rinsates of such cannot be placed in any water bodies and must be collected and returned to the FEC for disposition.
- The collection, handling and proposed disposal method must be specified in the approved study plan or QAPP.

4 Management of Hazardous IDW

Disposal of hazardous or suspected hazardous IDW must be specified in the approved study plan or QAPP for the study or investigation. Hazardous IDW must be disposed as specified in USEPA regulations. If appropriate, these wastes may be placed back in an active facility waste treatment system. These wastes may also be disposed in the source area from which they originated if doing so does not endanger human health or the environment.

If on-site disposal is not feasible, and if the wastes are suspected to be hazardous, appropriate tests must be conducted to make that determination. If they are determined to be hazardous wastes, they must be properly contained and labeled. They may be stored on the site for a maximum of 90 days before they must be manifested and shipped to a permitted treatment or disposal facility. Generation of hazardous IDW must be anticipated, if possible, to allow arrangements for proper containerization, labeling, transportation and disposal/treatment in accordance with USEPA regulations.

The generation of hazardous IDW should be minimized to conserve Division resources. Most routine studies should not produce any hazardous IDW, with the possible exception of spent solvents and, possibly, purged groundwater. The use of solvents during field cleaning of equipment should be minimized by using solvent-free cleaning procedures for routine cleaning and decontamination (see SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205). If solvents are needed, the volume should be minimized by using only the amount necessary and by capturing the residual solvent separately from the aqueous decontamination fluids (detergent/wash water mixes and water rinses).

At a minimum, the requirements of the management of hazardous IDW are as follows:

- Spent solvents must be left on-site with the permission of site operator and proper disposal arranged.
- All hazardous IDW must be containerized. Proper handling and disposal should be arranged prior to commencement of field activities.

Table 1: Disposal of IDW

TYPE	HAZARDOUS	NON - HAZARDOUS
PPE-Disposable	Containerize in plastic 5-gallon bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise return to FEC for proper disposal.	Place waste in trash bag. Place in dumpster with permission of site operator, otherwise return to FEC for disposal in dumpster.
PPE-Reusable	Decontaminate as per SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, if possible. If the equipment cannot be decontaminated, containerize in plastic 5-gallon bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise return to FEC for proper disposal.	Decontaminate as per SESDPROC-205, and return to FEC.
Spent Solvents	Containerize in original containers. Clearly identify contents. Leave on-site with permission of site operator and arrange for proper disposal.	N/A
Soil Cuttings	Containerize in DOT-approved container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in a 55-gallon steel drum with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. **
Groundwater	Containerize in DOT-approved container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. **
Decontamination Water	Containerize in DOT-approved container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. Decontamination water may also be disposed in a sanitary sewer system, with permission from the wastewater treatment plant representative, and if doing so does not endanger human health or the environment, or violate federal or state regulations.
Disposable Equipment	Containerize in DOT-approved container or 5-gallon plastic bucket with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal.	Containerize in an appropriate container with tight-fitting lid. Identify and leave on-site with permission of site operator, otherwise arrange with program site manager for testing and disposal. If unfeasible, return to FEC for disposal in dumpster.
Trash	N/A	Place waste in trash bag. Place in dumpster with permission of site operator, otherwise return to FEC for disposal in dumpster.

** **These materials may be placed on the ground if doing so does not endanger human health or the environment or violate federal or state regulations.**

ATTACHMENT E

USEPA Region 4-SOP

Soil Sampling,

SESDPROC-300-R1, Nov. 2007

Region 4 U.S. Environmental Protection Agency Science and Ecosystem Support Division Athens, Georgia	
OPERATING PROCEDURE	
Title: **Soil Sampling**	
Effective Date: November 1, 2007	**Number:** SESDPROC-300-R1
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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the SESD Field Quality Manager.

History	Effective Date
SESDPROC-300-R1, *Soil Sampling*, replaces SESDPROC-300-R0. **General** Corrected any typographical, grammatical and/or editorial errors. **Title Page** Changed title for Antonio Quinones from Environmental Investigations Branch to Enforcement and Investigations Branch. **Section 1.3** Updated information to reflect that the procedure is located on the H: drive of the LAN. Clarified Field Quality Manager (FQM) responsibilities. **Section 1.4** Updated referenced operating procedures due to changes in title names. Alphabetized and revised the referencing style for consistency. **Section 1.5.1** Corrected the title of the Safety, Health, and Environmental Management Program Procedures and Policy Manual. **Section 1.5.2, 4th bullet** Added references to the CFR and IATA's Dangerous Goods Regulations. **Section 2.7** Updated referenced operating procedures due to changes in title names.	November 1, 2007
SESDPROC-300-R0, Soil Sampling, Original Issue	February 05, 2007

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1 General Information

1.1 Purpose

This document describes general and specific procedures, methods and considerations to be used and observed when collecting soil samples for field screening or laboratory analysis.

1.2 Scope/Application

The procedures contained in this document are to be used by field personnel when collecting and handling soil samples in the field. On the occasion that SESD field personnel determine that any of the procedures described in this section are either inappropriate, inadequate or impractical and that another procedure must be used to obtain a soil sample, the variant procedure will be documented in the field log book and subsequent investigation report, along with a description of the circumstances requiring its use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the H: drive of the SESD local area network. The Field Quality Manager (FQM) is responsible for ensuring the most recent version of the procedure is placed on the H: drive and for maintaining records of review conducted prior to its issuance.

1.4 References

International Air Transport Authority (IATA). Dangerous Goods Regulations, Most Recent Version

SESD Operating Procedure for Sample and Evidence Management, SESDPROC-005, Most Recent Version

SESD Operating Procedure for Logbooks, SESDPROC-010, Most Recent Version

SESD Operating Procedure for Field Sampling Quality Control, SESDPROC-011, Most Recent Version

SESD Operating Procedure for Field X-Ray Fluorescence (XRF) Measurement, SESDPROC-107, Most Recent Version

SESD Operating Procedure for Equipment Inventory and Management, SESDPROC-108, Most Recent Version

SESD Operating Procedure for Field Equipment Cleaning and Decontamination, SESDPROC-205, Most Recent Version

SESD Operating Procedure for Packaging, Marking, Labeling and Shipping of Environmental and Waste Samples, SESDPROC-209, Most Recent Version

Title 49 Code of Federal Regulations, Pts. 171 to 179, Most Recent Version

United States Environmental Protection Agency (US EPA). 1981. "Final Regulation Package for Compliance with DOT Regulations in the Shipment of Environmental Laboratory Samples," Memo from David Weitzman, Work Group Chairman, Office of Occupational Health and Safety (PM-273), April 13, 1981.

US EPA. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. Region 4 Science and Ecosystem Support Division (SESD), Athens, GA

US EPA. Analytical Support Branch Laboratory Operations and Quality Assurance Manual. Region 4 SESD, Athens, GA, Most Recent Version

US EPA. Safety, Health and Environmental Management Program Procedures and Policy Manual. Region 4 SESD, Athens, GA, Most Recent Version

1.5 General Precautions

1.5.1 Safety

Proper safety precautions must be observed when collecting soil samples. Refer to the SESD Safety, Health and Environmental Management Program (SHEMP) Procedures and Policy Manual and any pertinent site-specific Health and Safety Plans (HASP) for guidelines on safety precautions. These guidelines, however, should only be used to complement the judgment of an experienced professional. Address chemicals that pose specific toxicity or safety concerns and follow any other relevant requirements, as appropriate.

1.5.2 Procedural Precautions

The following precautions should be considered when collecting soil samples.

- Special care must be taken not to contaminate samples. This includes storing samples in a secure location to preclude conditions which could alter the properties of the sample. Samples shall be custody sealed during long-term storage or shipment.

- Collected samples are in the custody of the sampler or sample custodian until the samples are relinquished to another party.
- If samples are transported by the sampler, they will remain under his/her custody or be secured until they are relinquished.
- Shipped samples shall conform to all U.S. Department of Transportation (DOT) rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179), and/or International Air Transportation Association (IATA) hazardous materials shipping requirements found in the current edition of IATA's Dangerous Goods Regulations.
- Documentation of field sampling is done in a bound logbook.
- Chain-of-custody documents shall be filled out and remain with the samples until custody is relinquished.
- All shipping documents, such as air bills, bills of lading, etc., shall be retained by the project leader in the project files.

2 Special Sampling Considerations

2.1 Soil Samples for Volatile Organic Compounds (VOC) Analysis

If samples are to be analyzed for volatile organic compounds, they should be collected in a manner that minimizes disturbance of the sample. For example, when sampling with a bucket auger, the sample for VOC analysis should be collected directly from the auger bucket (preferred) or from minimally disturbed material immediately after an auger bucket is emptied into the pan. The sample shall be containerized by filling an En Core® Sampler or other Method 5035 compatible container. ***Samples for VOC analysis are not homogenized.*** Preservatives may be required for some samples with certain variations of Method 5035. Consult the method or the principal analytical chemist to determine if preservatives are necessary.

2.2 Soil Sampling (Method 5035)

The following sampling protocol is recommended for site investigators assessing the extent of volatile organic compounds (VOC's) in soils at a project site. Because of the large number of options available, careful coordination between field and laboratory personnel is needed. The specific sampling containers and sampling tools required will depend upon the detection levels and intended data use. Once this information has been established, selection of the appropriate sampling procedure and preservation method best applicable to the investigation can be made.

2.2.1 Equipment

Soil for VOC analyses may be retrieved using any of the SESD soil sampling methods described in Sections 3 through 8 of this procedure. Once the soil has been obtained, the En Core® Sampler, syringes, stainless steel spatula, standard 2-oz. soil VOC container, or pre-prepared 40 ml vials may be used/required for sub-sampling. The specific sample containers and the sampling tools required will depend upon the data quality objectives established for the site or sampling investigation. The various sub-sampling methods are described below.

2.2.2 Sampling Methodology - Low Concentrations (<200 ug/kg)

When the total VOC concentration in the soil is expected to be less than 200 µg/kg, the samples may be collected directly with the En Core® Sampler or syringe. If using the syringes, the sample must be placed in the sample container (40 ml pre-prepared vial) immediately to reduce volatilization losses. The 40 ml vials should contain 10 ml of organic-free water for an un-preserved sample or approximately 10 ml of organic-free water and a preservative. It is recommended that the 40 ml vials be prepared and weighed by the laboratory (commercial sources are available which supply preserved and tared vials). When sampling directly with the En Core® Sampler, the vial must be immediately capped and locked

A soil sample for VOC analysis may also be collected with conventional sampling equipment. A sample collected in this fashion must either be placed in the final sample container (En Core® Sampler or 40 ml pre-prepared vial) immediately or the sample may be immediately placed into an intermediate sample container with no head space. If an intermediate container (usually 2-oz. soil jar) is used, the sample must be transferred to the final sample container (En Core® Sampler or 40 ml pre-prepared vial) as soon as possible, not to exceed 30 minutes.

NOTE: After collection of the sample into either the En Core® Sampler or other container, the sample must immediately be stored in an ice chest and cooled.

Soil samples may be prepared for shipping and analysis as follows:

En Core® Sampler - the sample shall be capped, locked, and secured in a plastic bag.

Syringe - Add about 3.7 cc (approximately 5 grams) of sample material to 40-ml pre-prepared containers. Secure the containers in a plastic bag. Do not use a custody seal on the container; place the custody seal on the plastic bag. Note: When using the syringes, it is important that no air is allowed to become trapped behind the sample prior to extrusion, as this will adversely affect the sample.

Stainless Steel Laboratory Spatulas - Add between 4.5 and 5.5 grams (approximate) of sample material to 40 ml containers. Secure the containers in a plastic bag. Do not use a custody seal on the container; place the custody seal on the plastic bag.

2.2.3 Sampling Methodology - High Concentrations (>200 ug/kg)

Based upon the data quality objectives and the detection level requirements, this high level method may also be used. Specifically, the sample may be packed into a single 2-oz. glass container with a screw cap and septum seal. The sample container must be filled quickly and completely to eliminate head space. Soils\sediments containing high total VOC concentrations may also be collected as described in Section 2.2.2, Sampling Methodology - Low Concentrations, and preserved using 10 ml methanol.

2.2.4 Special Techniques and Considerations for Method 5035

Effervescence

If low concentration samples effervesce from contact with the acid preservative, then either a test for effervescence must be performed prior to sampling, or the investigators must be prepared to collect each sample both preserved or un-preserved as needed, or all samples must be collected unpreserved.

To check for effervescence, collect a test sample and add to a pre-preserved vial. If preservation (acidification) of the sample results in effervescence (rapid formation of bubbles) then preservation by acidification is not acceptable, and the sample must be collected un-preserved.

If effervescence occurs and only pre-preserved sample vials are available, the preservative solution may be placed into an appropriate hazardous waste container and the vials triple rinsed with organic free water. An appropriate amount of organic free water, equal to the amount of preservative solution, should be placed into the vial. The sample may then be collected as an un-preserved sample. Note that the amount of organic free water placed into the vials will have to be accurately measured.

Sample Size

While this method is an improvement over earlier ones, field investigators must be aware of an inherent limitation. Because of the extremely small sample size and the lack of sample mixing, sample representativeness for VOC's may be reduced compared to samples with larger volumes collected for other constituents. The sampling design and objectives of the investigation should take this into consideration.

Holding Times

Sample holding times are specified in the Analytical Support Branch *Laboratory Operations and Quality Assurance Manual* (ASBLOQAM), Most Recent Version. Field investigators should note that the holding time for an un-preserved VOC soil/sediment sample is 48 hours. Arrangements should be made to ship the soil/sediment VOC samples to the laboratory by overnight delivery the day they are collected so the laboratory may preserve and/or analyze the sample within 48 hours of collection.

Percent Moisture

Samplers must ensure that the laboratory has sufficient material to determine percent moisture in the VOC soil/sediment sample to correct the analytical results to dry weight. If other analyses requiring percent moisture determination are being performed upon the sample, these results may be used. If not, a separate sample (minimum of 2 oz.) for percent moisture determination will be required. The sample collected for Percent Moisture may also be used by the laboratory to check for preservative compatibility.

Safety

Methanol is a toxic and flammable liquid. Therefore, methanol must be handled with all required safety precautions related to toxic and flammable liquids. Inhalation of methanol vapors must be avoided. Vials should be opened and closed quickly during the sample preservation procedure. Methanol must be handled in a ventilated area. Use protective gloves when handling the methanol vials. Store methanol away from sources of ignition such as extreme heat or open flames. The vials of methanol should be stored in a cooler with ice at all times.

Shipping

Methanol and sodium bisulfate are considered dangerous goods, therefore shipment of samples preserved with these materials by common carrier is regulated by the U.S. Department of Transportation and the International Air Transport Association (IATA). The rules of shipment found in Title 49 of the Code of Federal Regulations (49 CFR parts 171 to 179) and the current edition of the IATA Dangerous Goods Regulations must be followed when shipping methanol and sodium bisulfate. Consult the above documents or the carrier for additional information. Shipment of the quantities of methanol and sodium bisulfate used for sample preservation falls under the exemption for small quantities.

The summary table on the following page lists the options available for compliance with SW846 Method 5035. The advantages and disadvantages are noted for each option. SESD's goal is to minimize the use of hazardous material (methanol and sodium bisulfate) and minimize the generation of hazardous waste during sample collection.

2.3 Dressing Soil Surfaces

Any time a vertical or near vertical surface is sampled, such as achieved when shovels or similar devices are used for subsurface sampling, the surface should be dressed (scraped) to remove smeared soil. This is necessary to minimize the effects of contaminant migration interferences due to smearing of material from other levels.

Table 1: Method 5035 Summary

OPTION	PROCEDURE	ADVANTAGES	DISADVANTAGES
1	Collect 2 - 40 mL vials with ~5 grams of sample and 1 - 2 oz., glass w/septum lid for screening, % moisture and preservative compatibility	Screening conducted by lab	Presently a 48 hour holding time for unpreserved samples Sample containers must be tared
2	Collect 3 En Core® Samplers; and 1- 2 oz., glass w/septum lid for screening, % moisture and preservative compatibility	Lab conducts all preservation/preparation procedures	Presently a 48 hour holding time for preparation of samples
3	Collect 2 - 40 ml vials with 5 grams of sample and preserve w/methanol or sodium bisulfate and 1 - 2-oz., glass w/septum lid for screening, % moisture and preservative compatibility	High level VOC samples may be composited Longer holding time	Hazardous materials used in field Sample containers must be tared
4	Collect 1 - 2-oz., glass w/septum lid for analysis, % moisture and preservative compatibility	Lab conducts all preservation/preparation procedures	May have significant VOC loss

2.4 Special Precautions for Trace Contaminant Soil Sampling

- A clean pair of new, non-powdered, disposable gloves will be worn each time a different sample is collected and the gloves should be donned immediately prior to sampling. The gloves should not come in contact with the media being sampled and should be changed any time during sample collection when their cleanliness is compromised.
- Sample containers for samples suspected of containing high concentrations of contaminants shall be collected, handled and stored separately.
- All background samples shall be segregated from obvious high concentration or waste samples. Sample collection activities shall proceed progressively from the least suspected contaminated area to the most suspected contaminated area if sampling devices are to be reused. Samples of waste or highly contaminated media must not be placed in the same ice chest as environmental (i.e., containing low contaminant levels) or background samples.

- If possible, one member of the field sampling team should take all the notes and photographs, fill out tags, etc., while the other members collect the samples.
- Samplers must use new, verified certified-clean disposable or non-disposable equipment cleaned according to procedures contained in SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205), for collection of samples for trace metals or organic compound analyses.

2.5 Sample Homogenization

1. If sub-sampling of the primary sample is to be performed in the laboratory, transfer the entire primary sample directly into an appropriate, labeled sample container(s). Proceed to step 5.

2. If sub-sampling the primary sample in the field or compositing multiple primary samples in the field, place the sample into a glass or stainless steel homogenization container and mix thoroughly. Each aliquot of a composite sample should be of the same approximate volume.

3. All soil samples must be thoroughly mixed to ensure that the sample is as representative as possible of the sample media. ***Samples for VOC analysis are not homogenized.*** The most common method of mixing is referred to as quartering. The quartering procedure should be performed as follows:

    - The material in the sample pan should be divided into quarters and each quarter should be mixed individually.
    - Two quarters should then be mixed to form halves.
    - The two halves should be mixed to form a homogenous matrix.

    This procedure should be repeated several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over.

4. Place the sample into an appropriate, labeled container(s) by using the alternate shoveling method and secure the cap(s) tightly. The alternate shoveling method involves placing a spoonful of soil in each container in sequence and repeating until the containers are full or the sample volume has been exhausted. Threads on the container and lid should be cleaned to ensure a tight seal when closed.

5. Return any unused sample material back to the auger, drill or push hole from which the sample was collected.

2.6 Quality Control

If possible, a control sample should be collected from an area not affected by the possible contaminants of concern and submitted with the other samples. This control sample should be collected as close to the sampled area as possible and from the same soil type. Equipment blanks should be collected if equipment is field cleaned and re-used on-site or if necessary to document that low-level contaminants were not introduced by sampling tools. SESD Operating Procedure for Field Sampling Quality Control (SESDPROC-011) contains other procedures that may be applicable to soil sampling investigations.

2.7 Records

Field notes, recorded in a bound field logbook, will be generated, as well as chain-of-custody documentation, as described in the SESD Operating Procedure for Logbooks (SESDPROC-010) and the SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005).

3 Manual Soil Sampling Methods

3.1 General

These methods are used primarily to collect surface and shallow subsurface soil samples. Surface soils are generally classified as soils between the ground surface and 6 to 12 inches below ground surface. The most common interval is 0 to 6 inches, however the data quality objectives of the investigation may dictate another interval, such as 0 to 3 inches for risk assessment purposes. The shallow subsurface interval may be considered to extend from approximately 12-inches below ground surface to a site-specific depth at which sample collection using manual collection methods becomes impractical.

3.2 Spoons

Stainless steel spoons may be used for surface soil sampling to depths of approximately 6-inches below ground surface where conditions are generally soft and non-indurated and there is no problematic vegetative layer to penetrate.

3.2.1 Special Considerations When Using Spoons

- When using stainless steel spoons, consideration must be given to the procedure used to collect the volatile organic compound sample. If the soil being sampled is cohesive and holds its in situ texture in the spoon, the En Core® Sampler or syringe used to collect the sub-sample for Method 5035 should be plugged directly from the spoon. If, however, the soil is not cohesive and crumbles when removed from the ground surface for sampling, consideration should be given to plugging the sample for Method 5035 directly from the ground surface at a depth appropriate for the investigation Data Quality Objectives.
- When compositing, make sure that each composite location (aliquot) consist of equal volumes, i.e., same number of equal spoonfuls.
- If a thick, matted root zone is present at or near the surface, it should be removed before the sample is collected

3.3 Hand Augers

Hand augers may be used to advance boreholes and collect soil samples in the surface and shallow subsurface intervals. Typically, 4-inch stainless steel auger buckets with cutting heads are used. The bucket is advanced by simultaneously pushing and turning using an attached handle.

3.3.1 Surface Soil Sampling

When conducting surface soil sampling with hand augers, the auger buckets may be used with a handle alone or with a handle and extensions. The bucket is advanced to the appropriate depth and the contents are transferred to the homogenization container for processing. Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

3.3.2 Subsurface Soil Sampling

Hand augers are the most common equipment used to collect shallow subsurface soil samples. Auger holes are advanced one bucket at a time until the sample depth is achieved. When the sample depth is reached, the bucket used to advance the hole is removed and a clean bucket is attached. The clean auger bucket is then placed in the hole and filled with soil to make up the sample and removed.

The practical depth of investigation using a hand auger depends upon the soil properties and depth of investigation. In sand, augering is usually easily performed, but the depth of collection is limited to the depth at which the sand begins to flow or collapse. Hand augers may also be of limited use in tight clays or cemented sands. In these soil types, the greater the depth attempted, the more difficult it is to recover a sample due to increased friction and torqueing of the hand auger extensions. At some point these problems become so severe that power equipment must be used.

3.3.3 Special Considerations for Soil Sampling with the Hand Auger

- Because of the tendency for the auger bucket to scrape material from the sides of the auger hole while being extracted, the top several inches of soil in the auger bucket should be discarded prior to placing the bucket contents in the homogenization container for processing.
- Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035. Collect the VOC sample directly from the auger bucket, if possible.
- Power augers, such as the Little Beaver®, and drill rigs may be used to advance boreholes to depths for subsurface soil sampling with the hand auger. They may not be used for sample collection. When power augers are used to advance a borehole to depth for sampling, care must be taken that exhaust fumes, gasoline and/or oil do not contaminate the borehole or area in the immediate vicinity of sampling.
- When a new borehole is advanced, the entire hand auger assembly must be replaced with a properly decontaminated hand auger assembly.

4 Direct Push Soil Sampling Methods

4.1 General

These methods are used primarily to collect shallow and deep subsurface soil samples. Three methods are available for use with either the Geoprobe® or the drill rig adapted with a hydraulic hammer. All methods involve the collection and retrieval of the soil sample within a thin-walled liner. The following sections describe each of the specific sampling methods that can be accomplished using direct push techniques, along with details specific to each method.

4.2 Large Bore® Soil Sampler

The Large Bore® (LB) sampler is a solid barrel direct push sampler equipped with a piston-rod point assembly used primarily for collection of depth-discrete subsurface soil samples. The sample barrel is approximately 30-inches (762 mm) long and has a 1.5-inch (38 mm) outside diameter. The LB® sampler is capable of recovering a discrete sample core 22 inches x 1.0 inch (559 mm x 25 mm) contained inside a removable liner. The resultant sample volume is a maximum of 283 ml.

After the LB® sample barrel is equipped with the cutting shoe and liner, the piston-rod point assembly is inserted, along with the drive head and piston stop assembly. The assembled sampler is driven to the desired sampling depth, at which time the piston stop pin is removed, freeing the push point. The LB® sampler is then pushed into the soil a distance equal to the length of the LB® sample barrel. The probe rod string, with the LB® sampler attached, is then removed from the subsurface. After retrieval, the LB® sampler is then removed from the probe rod string. The drive head is then removed to allow removal of the liner and soil sample.

4.3 Macro-Core® Soil Sampler

The Macro-Core® (MC) sampler is a solid barrel direct push sampler equipped with a piston-rod point assembly used primarily for collection of either continuous or depth-discrete subsurface soil samples. Although other lengths are available, the standard MC® sampler has an assembled length of approximately 52 inches (1321 mm) with an outside diameter of 2.2 inches (56 mm). The MC® sampler is capable of recovering a discrete sample core 45 inches x 1.5 inches (1143 mm x 38 mm) contained inside a removable liner. The resultant sample volume is a maximum of 1300 ml. The MC® sampler may be used in either an open-tube or closed-point configuration. Samples collected for chemical analyses must be collected with the closed-point configuration. If used for collection of soil for stratigraphic descriptions, the open-tubed configuration is acceptable.

4.4 Dual Tube Soil Sampling System

The Dual Tube 21 soil sampling system is a direct push system for collecting continuous core samples of unconsolidated materials from within a sealed outer casing of 2.125-inch (54 mm) OD probe rod. The samples are collected within a liner that is threaded onto the leading end of a string of 1.0-inch diameter probe rod. Collected samples have a volume of up to 800 ml in the form of a 1.125-inch x 48-inch (29 mm x 1219 mm) core. Use of this method allows for collection of continuous core inside a cased hole, minimizing or preventing cross-contamination between different intervals during sample collection. The outer casing is advanced, one core length at a time, with only the inner probe rod and core being removed and replaced between samples. If the sampling zone of interest begins at some depth below ground surface, a solid drive tip must be used to drive the dual tube assembly and core to its initial sample depth.

4.5 Special Considerations When Using Direct Push Sampling Methods

- *Liner Use and Material Selection* – Due to the mode of operation, the samples must be collected with a liner. Liners are available in the following materials: stainless steel, brass, cellulose acetate butyrate (CAB), PETG, polyvinyl chloride (PVC) and Teflon®. For the majority of environmental investigations conducted by EIB, either CAB or Teflon® liners are used. If samples are collected for organic compound analyses, Teflon® liners are required. CAB or PVC liners may be used if metals or other inorganic constituents are the object of the investigation.
- *Sample Orientation* – When the liners and associated sample are removed from the sample tubes, it is important to maintain the proper orientation of the sample. This is particularly important when multiple sample depths are collected from the same push. It is also important to maintain proper orientation to define precisely the depth at which an aliquot was collected. Maintaining proper orientation is typically accomplished using vinyl end caps. Convention is to place red caps on the top of the liner and black caps on the bottom to maintain proper sample orientation. Orientation can also be indicated by marking on the exterior of the liner with a permanent marker.
- *Core Catchers* – Occasionally the material being sampled lacks cohesiveness and is subject to crumbling and falling out of the sample liner. In cases such as these, the use of core catchers on the leading end of the sampler may help retain the sample until it is retrieved to the surface. Materials of construction for core catchers must be consistent with the type of liner used, i.e., if stainless steel liners are required, stainless steel core catchers must be used.
- *VOC Sample Collection* - Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

5 Split Spoon/Drill Rig Methods

5.1 General

Split spoon sampling methods are used primarily to collect shallow and deep subsurface soil samples. All split spoon samplers, regardless of size, are basically split cylindrical barrels that are threaded on each end. The leading end is held together with a beveled threaded collar that functions as a cutting shoe. The other end is held together with a threaded collar that serves as the sub used to attach the spoon to the string of drill rod. Two basic methods are available for use, including the smaller diameter standard split spoon, driven with the drill rig safety hammer, and the larger diameter continuous split spoon, advanced inside and slightly ahead of the lead auger during hollow stem auger drilling. The following sections describe each of the specific sampling methods, along with details specific to each method.

5.2 Standard Split Spoon

A drill rig is used to advance a borehole to the target depth. The drill string is then removed and a standard split spoon is attached to a string of drill rod. Split spoons used for soil sampling must be constructed of stainless steel and are typically 2.0-inches OD (1.5-inches ID) and 18-inches to 24-inches in length. Other diameters and lengths are common and may be used if constructed of the proper material. After the spoon is attached to the string of drill rod it is lowered into the borehole. The drill rig safety hammer is then used to drive the split spoon into the soil at the bottom of the borehole. After the split spoon has been driven into the soil, filling the spoon, it is retrieved to the surface, where it is removed from the drill rod string and opened for sample acquisition.

5.3 Continuous Split Spoon

The continuous split spoon is a large diameter split spoon that is advanced into the soil column inside a hollow stem auger. Continuous split spoons are typically 3-inches to 5-inches in diameter and either 5-feet or 10-feet in length, although the 5-foot long samplers are most common. After the auger string has been advanced into the soil column a distance equal to the length of the sampler being used it is returned to the surface. The sampler is removed from inside the hollow stem auger and the threaded collars are removed. The split spoon is then opened for sampling.

5.4 Special Considerations When Using Split Spoon Sampling Methods

- Always discard the top several inches of material in the spoon before removing any portion for sampling. This material normally consists of borehole wall material that has sloughed off of the borehole wall after removal of the drill string prior to and during inserting the split spoon.
- Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

6 Shelby Tube/Thin-Walled Sampling Methods

6.1 General

Shelby tubes, also referred to generically as thin-walled push tubes or Acker thin-walled samplers, are used to collect subsurface soil samples in cohesive soils and clays during drilling activities. In addition to samples for chemical analyses, Shelby tubes are also used to collect relatively undisturbed soil samples for geotechnical analyses, such as hydraulic conductivity and permeability, to support hydrogeologic characterizations at hazardous waste and other sites.

6.2 Shelby Tube Sampling Method

A typical Shelby tube is 30-inches in length and has a 3.0-inch OD (2.875 ID) and may be constructed of steel, stainless steel, galvanized steel, or brass. They also typically are attached to push heads that are constructed with a ball-check to aid in holding the contained sample during retrieval. If used for collecting samples for chemical analyses, it must be constructed of stainless steel. If used for collecting samples for standard geotechnical parameters, any material is acceptable.

To collect a sample, the tube is attached to a string of drill rod and is lowered into the borehole, where the sampler is then pressed into the undisturbed clay or silts by hydraulic force. After retrieval to the surface, the tube containing the sample is then removed from the sampler head. If samples for chemical analyses are needed, the soil contained inside the tube is then removed for sample acquisition. If the sample is collected for geotechnical parameters, the tube is typically capped, maintaining the sample in its relatively undisturbed state, and shipped to the appropriate geotechnical laboratory.

6.3 Special Considerations When Using Split Spoon Sampling Methods

Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

7 Backhoe Sampling Method

7.1 General

Backhoes may be used in the collection of surface and shallow subsurface soil samples. The trenches created by excavation with a backhoe offer the capability of collecting samples from very specific intervals and allow visual correlation with vertically and horizontally adjacent material. If possible, the sample should be collected without entering the trench. Samples may be obtained from the trench wall or they may be obtained directly from the bucket at the surface. The following sections describe various techniques for safely collecting representative soil samples with the aid of a backhoe.

7.2 Scoop and Bracket Method

If a sample interval is targeted from the surface, it can be sampled using a stainless steel scoop and bracket. First a scoop and bracket are affixed to a length of conduit and is lowered into the backhoe pit. The first step is to take the scoop and scrape away the soil comprising the surface of the excavated wall. This material likely represents soil that has been smeared by the backhoe bucket from adjacent material. After the smeared material has been scraped off, the original stainless steel scoop is removed and a clean stainless steel scoop is placed on the bracket. The clean scoop can then be used to remove sufficient volume of soil from the excavation wall to make up the required sample volume.

7.3 Direct-From-Bucket Method

It is also possible to collect soil samples directly from the backhoe bucket at the surface. Some precision with respect to actual depth or location may be lost with this method but if the soil to be sampled is uniquely distinguishable from the adjacent or nearby soils, it may be possible to characterize the material as to location and depth. In order to ensure representativeness, it is also advisable to dress the surface to be sampled by scraping off any smeared material that may cross-contaminate the sample.

7.4 Special Considerations When Sampling with a Backhoe

- Do not physically enter backhoe excavations to collect a sample. Use either procedure 7.2, Scoop and Bracket Method, or procedure 7.3, Direct-From-Bucket Method to obtain soil for sampling.
- Smearing is an important issue when sampling with a backhoe. Measures must be taken, such as dressing the surfaces to be sampled (see Section 2.3), to mitigate problems with smearing.

- Paint, grease and rust must be removed and the bucket decontaminated prior to sample collection.
- Observe precautions for volatile organic compound sample collection found in Section 2.2.4, Special Techniques and Considerations for Method 5035.

ATTACHMENT F

USEPA Region 4-SOP

Field Sampling Quality Control

SESDPROC-011-R3, October 2010

Region 4 **U.S. Environmental Protection Agency** **Science and Ecosystem Support Division** **Athens, Georgia**
OPERATING PROCEDURE
Title: **Field Sampling Quality Control**

Effective Date: October 15, 2010	**Number:** SESDPROC-011-R3

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Revision History

This table shows changes to this controlled document over time. The most recent version is presented in the top row of the table. Previous versions of the document are maintained by the Document Control Coordinator.

History	Effective Date
SESDPROC-011-R3, *Field Sampling Quality Control*, replaces SESDPROC-011-R2 **Cover Page:** The Enforcement and Investigations Branch Chief was changed from Antonio Quinones to Archie Lee. The FQM was changed from Laura Ackerman to Liza Montalvo. **Section 1.2:** Added the following statement: Mention of trade names or commercial products does not constitute endorsement or recommendation for use. **Section 1.3:** Omitted reference to the H: drive of the LAN. **Section 2.9**: On the first paragraph, replaced the word "will" with "should" on the two instances where "will" was mentioned. **Section 4.2, Subsection 1**: Removed volatiles from list of analyses for 1-liter amber containers. Added volatile organic compound to list of analyses for 8-oz. clear glass containers.	October 15, 2010
SESDPROC-011-R2, *Field Sampling Quality Control*, replaces SESDPROC-011-R1 **Revision History** Changed Field Quality Manager to Document Control Coordinator. **Section 1.3** Changed Field Quality Manager to Document Control Coordinator. **Section 2.6** Added item #8. **Section 4.1** Added clarifying language to item #5. **Section 4.2** Added "volatiles" to item #1. Added "Note" at end of item #1. **Section 4.4.1** Changed "quarter" to "year" in second paragraph.	January 28, 2008

SESDPROC-011-R1, *Field Sampling Quality Control*, replaces SESDPROC-011-R0. **Section 1.3** Modified requirements for maintaining official copy of procedure. **Section 1.4** Stated that variability should be accounted for depending on the data quality objectives for the study. Added definitions for branch field equipment manager and de-ionized water. Removed definitions for representative sample, sample representativeness, accuracy, precision, and bias. **Section 2.5** Records of sample preservation, including ice, should be documented in the field log books. **Section 2.6** Added the SESD glove and bottle return policy. The glove and bottle return policy was previously in SESDPROC-108-R0, *Equipment and Supply Management*. **Section 3.3** Stated that variability samples will be collected in accordance to project DQOs. Removed definition for "major project". **Section 3.5** Added double volume requirement for SVOC/pesticide/PCB MS/MSD sample collection. **Section 4.1** Modified requirements for servicing both field and FEC organic-free water systems from quarterly to at least once per 180 days. **Section 4.2, Subsection 1** Added analytical requirements for testing of Teflon® tubing. **Section 4.2, Subsection 5** Modified Silastic® or Tygon® tubing testing requirements to state that new lot are required to be tested quarterly. **Section 4.4.2** Modified requirements that project leaders provide final report to QAO. Project Leaders will provide QA data to QAO.	October 19, 2007
SESDPROC-011-R0, *Field Sampling Quality Control*, Original Issue	February 5, 2007

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1 General Information

1.1 Purpose

This document describes procedures established to ensure the quality of SESD field sampling activities, including Field Equipment Center (FEC) operations involving preparation of sampling and support equipment for field operations. Collectively, these procedures ensure that field sampling teams are provided with equipment that is suitable for sampling use, and that field sampling is conducted using proper procedures, resulting in the collection of representative samples. Strict adherence to these procedures forms the basis for an acceptable field sampling quality assurance program.

1.2 Scope/Application

The procedures contained in this document are to be used by field investigators when collecting and handling samples in the field and when preparing sampling equipment for SESD field investigations. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

1.3 Documentation/Verification

This procedure was prepared by persons deemed technically competent by SESD management, based on their knowledge, skills and abilities and have been tested in practice and reviewed in print by a subject matter expert. The official copy of this procedure resides on the SESD local area network (LAN). The Document Control Coordinator (DCC) is responsible for ensuring the most recent version of the procedure is placed on the LAN and for maintaining records of review conducted prior to its issuance.

1.4 Definitions

1.4.1 Sample

A part of a larger lot, usually a volume, area, period or population.

1.4.2 Variability

The range or "distribution" of results around the mean value obtained from samples within a population. There are three types of variability which should be measured or otherwise accounted for in field sampling, depending on the data quality objectives (DQO) for the study:

1. Temporal Variability

   Temporal variability is the range of results due to changes in contaminant concentrations over time. An example would be the range of concentrations obtained for a given parameter in wastewater samples collected at different times from an outfall where contaminant concentrations vary over time.

2. Spatial Variability

   Spatial variability is the range of results due to changes in contaminant concentrations as a function of their location. An example would be the range of concentrations obtained for a given parameter in surface soil from a site where discreet "hot spots" are present due to localized releases of contaminants on otherwise uncontaminated soil.

3. Sample Handling Variability

   Sample handling variability is the range of results due to the sample collection and handling techniques used by the sampler. This variability manifests itself as a positive bias due to errors such as unclean sampling equipment, cross contamination, etc., or a negative bias due to improper containers or sample preservation.

1.4.3 Grab Sample

An individual sample collected from a single location at a specific time or period of time. Grab samples are generally authoritative in nature.

1.4.4 Composite Sample

A sample collected over a temporal or spatial range that typically consists of a series of discrete, equal samples (or "aliquots") which are combined or "composited." A composite sample represents the average characteristics of the population under consideration. Four types of composite samples are listed below:

1. Time Composite (TC) – a sample comprised of a varying number of discrete samples or "aliquots" collected at equal time intervals during the compositing period. The TC sample is typically used to sample wastewater or streams.

2. Flow Proportional Composite (FPC) – A sample consisting of discrete samples or "aliquots" collected at a rate proportional to flow. The aliquots are collected during the compositing period by either a time-varying/constant volume (TV/CV) method ("automated flow proportioning") or a time-constant/varying volume (TC/VV) method ("manual flow proportioning"). The TV/CV method is typically used with automatic

samplers that are paced by a flow meter. The TC/VV method is a manual method that individually proportions a series of discretely collected aliquots. The FPC is typically used when sampling wastewater.

3. Areal Composite – a sample composited from individual, equal aliquots collected on an areal or horizontal cross-sectional basis. Each aliquot is collected in an identical manner. Examples include sediment composites from quarter-point sampling of streams and soil samples from within grids.

4. Vertical Composite – a sample composited from individual, equal aliquots collected from a vertical cross section. Each aliquot is collected in an identical manner. Examples include vertical profiles of soil/sediment columns, lakes, and estuaries.

1.4.5 De-ionized Water

Tap water that has been treated by passing it through a standard de-ionizing resin column. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds (i.e., at or above analytical detection limits) as defined by a standard Inductively Coupled Argon Plasma Spectrophotometer (ICP) (or equivalent) scan. De-ionized water obtained by other methods is acceptable, as long as it meets the above analytical criteria. Organic-free water may be substituted for de-ionized water.

1.4.6 Branch Field Equipment Manager

Staff, designated by management, who are responsible for ensuring that the procedures for Equipment Inventory and Management are followed. At least one Branch Field Equipment Manager (BFEM) will be designated for the Enforcement and Investigations Branch (EIB) and the Ecological Assessment Branch (EAB).

1.5 References

SESD Safety, Health and Environmental Management Program (SHEMP) Manual, Most Recent Version

SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005-most recent version)

SESD Operating Procedure for Competency and Proficiency Testing, (SESDPROC-006, most recent version)

SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108-most recent version)

SESD Operating Procedure for Sediment Sampling (SESDPROC-200-most recent version)

SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205-most recent version)

SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206-most recent version)

SESD Operating Procedure for Soil Sampling (SESDPROC-300-most recent version)

SESD Operating Procedure for Waste Sampling (SESDPROC-302-most recent version)

USEPA Region 4 Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), November 2001

USEPA Region 4 Analytical Support Branch Laboratory Operations and Quality Assurance Manual (ASBLOQAM), Most Recent Version

Loan-In Form (SESDFORM-011, most recent version)

SESD Operating Procedure for Packing, Marking, Labeling, and Shipping of Environmental and Waste Samples (SESDPROC-209, most recent version)

SESD Operating Procedure for Training (SESDPROC-007, most recent version)

SESD Operating Procedure for Corrective Action (SESDPROC-009, most recent version)

SESD Guidance for Design and Installation of Monitoring Wells (SESDGUID-101, most recent version)

2 Field Sampling Quality Control Considerations

This section provides guidelines for establishing quality control procedures for sampling activities. Strict adherence to all of the standard operating procedures outlined in this subsection forms the basis for an acceptable sampling quality assurance program.

2.1 Experience Requirements

There is no substitute for field experience. This field experience will be gained by on-the-job training using the "buddy" system. Each new investigator will accompany an experienced employee on as many different types of field studies as possible. During this training period, the new employee will be permitted to perform all facets of field investigations, including sampling, under the direction and supervision of senior investigators. Specific requirements covering experience, competency and proficiency are found in the SESD Operating Procedure for Competency and Proficiency Testing (SESDPROC-006) and SESD Operating Procedure for Training (SESDPROC-007).

2.2 Traceability Requirements

All sample collection and measurement activities will be traceable through field records to the person collecting the sample or making the measurement. All maintenance and calibration records for sampling and measurement equipment (where appropriate) will be kept so that they are similarly traceable. The SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108) contain specific procedures to be followed that ensure traceability.

2.3 Chain-of-Custody

Specific chain-of-custody procedures are included in SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005). These procedures will ensure that evidence collected during an investigation will withstand scrutiny during litigation. To assure that procedures are being followed, it is recommended that field investigators or their designees audit chain-of-custody entries, tags or labels, field notes, and any other recorded information for accuracy. Additionally, the SESD FQM will randomly conduct reviews of project files to ensure that quality procedures are being followed.

2.4 Sampling Equipment Construction Material

Sampling equipment construction materials can affect sample analytical results. Field investigators will ensure the sample equipment construction material will not introduce contaminants to the sample being collected.

2.5 Sample Preservation

Samples for some analyses must be preserved in order to maintain their integrity. Preservatives required for routine analyses of samples collected are found in the USEPA Region 4 Analytical Support Branch Laboratory Operations and Quality Assurance Manual (ASBLOQAM). All chemical preservatives used will be supplied by the Region 4 laboratory. All samples requiring preservation should be preserved immediately upon collection in the field. Records of sample preservation, including ice, will be documented in the field log books.

Samples that **should not** be preserved in the field are:

1. Those collected within a hazardous waste site that are known or thought to be highly contaminated with toxic materials which may be highly reactive. Barrel, drum, closed container, spillage, or other source samples from hazardous waste sites are not to be preserved with any chemical.

2. Those that have extremely low or high pH or samples that may generate potentially dangerous gases if they were preserved according to the ASBLOQAM.

All samples preserved with chemicals will be clearly identified by indication on the sample tag or label that the sample is preserved. If samples normally requiring preservation were not preserved, field records should clearly specify the reason. Samples shipped by air will not be preserved with nitric acid, hydrochloric acid, sodium hydroxide, or sulfuric acid in excess of the amount specified in the ASBLOQAM.

2.6 Sample Collection Precautions

In order to prevent cross-contamination during sample collection, the following precautions will be taken:

1. A clean pair of new, non-powdered, disposable latex gloves will be worn each time a different location is sampled and the gloves should be donned immediately prior to sampling. The gloves should not come into contact with the media being sampled.

2. Sample containers for source samples or samples suspected of containing high concentrations of contaminants will be placed in separate plastic bags immediately after collecting, tagging, etc.

3. If possible, environmental (low concentration) samples and source or waste samples (high concentration) should be collected by different field teams. If different field teams cannot be used, all environmental samples should be collected first and placed in separate ice chests or shipping containers. Samples of waste or highly contaminated samples should never be placed in the same ice

chest as environmental samples. Ice chests or shipping containers for source or waste samples or any samples suspected to contain high concentrations of contaminants will be lined with new, clean, plastic bags.

4. If possible, one member of the field sampling team should record all of the field notes, collect GPS data, etc., while the other members collect the samples.

5. When sampling surface water and sediment at the same location, the water sample should always be collected before the sediment sample is collected.

6. Sample collection activities should proceed progressively from the least suspected contaminated area to the most suspected contaminated area.

7. Investigators should use equipment constructed of Teflon®, stainless steel, or glass that has been properly pre-cleaned according to either the SESD Operating Procedure for Field Equipment Cleaning and Decontamination (SESDPROC-205) or the SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206) for collection of samples for trace metals or organic compounds analyses. Teflon® or glass is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC should <u>not</u> be used to collect samples for trace organic compounds analyses.

8. Field investigators should ensure the sample containers they are using have been verified as suitable for the analyses that will be conducted on the samples through the quality control procedures discussed in Section 4 of this procedure.

Upon returning from the field, un-used sample containers will be examined by project leaders to determine whether bottles should be discarded, recycled, or re-shelved for use on other projects. A load-in form (SESDFORM-011) will be completed and signed by project leaders to identify the future use of sample containers returning from the field. Opened boxes of sampling containers that can be re-used, will be segregated from sealed boxes of new containers.

Opened bags of latex gloves returning from the field will be segregated from unopened gloves and will not be re-used for sample collection on other projects.

2.7 Sample Handling and Mixing

Once a sample has been collected, it may have to be transferred into separate containers for different analyses. Sample transfer should be done as soon as possible. If necessary, aqueous samples may be collected into a single, larger container for homogenization and transferred into individual sample containers. However, aqueous samples collected for volatile organic compounds, oil and grease, bacteria, sulfides, and phenols analyses may not be transferred using this procedure.

It is extremely important that waste (when appropriate), soil, and sediment samples be mixed thoroughly to ensure that the sample is representative of the sample media. The most common method of mixing is referred to as quartering. The quartering procedure should be performed as follows:

1. The material in the sample pan should be divided into quarters and each quarter should be mixed individually.

2. Two quarters should then be mixed to form halves.

3. The two halves should be mixed to form a homogenous matrix.

This procedure should be repeated several times until the sample is adequately mixed. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over.

2.8 Special Handling of Samples for Volatile Organic Compounds Analysis

Water samples to be analyzed for volatile organic compounds should be stored in 40-ml septum vials with screw cap and Teflon®-silicone disk in the cap to prevent contamination of the sample by the cap. The disks should be placed in the caps (Teflon® side to be in contact with the sample) in the laboratory prior to the beginning of the field investigation.

The vials should be completely filled to prevent volatilization, and extreme caution should be exercised when filling a vial to avoid any turbulence which could also produce volatilization. The sample should be carefully poured down the side of the vial to minimize turbulence. As a rule, it is best to gently pour the last few drops into the vial so that surface tension holds the water in a convex meniscus. The cap is then applied and some overflow is lost, but the air space in the bottle is eliminated. After capping, turn the bottle over and tap it to check for bubbles. If a bubble or bubbles are present, the vial should be topped off using a minimal amount of sample to re-establish the meniscus. Care should be taken not to flush any preservative out of the vial during topping off. If, after topping off and capping the vial, bubbles are still present, a new vial should be obtained and the sample re-collected.

Soil and sediment samples for VOC analyses should be collected and handled as specified in the SESD Operating Procedure for Soil Sampling (SESDPROC-300), Waste Sampling (SESDPROC-302) or the SESD Operating Procedure for Sediment Sampling (SESDPROC-200). Soil and sediment samples collected for VOC analyses should <u>not</u> be mixed.

2.9 Sample Storage and Transport

After collection, sample handling should be minimized. Field investigators should use extreme care to ensure that samples are not contaminated during storage. Environmental and waste samples are typically stored in coolers. To reduce the risk of cross contamination, smaller sample containers such as 8 ounce glass jars, 40 ml VOA vials, and one-liter amber bottles should be placed inside of sealed, plastic bags before being placed in the cooler. If ice is required for preservation of the samples, the ice should be contained in a plastic bag or some equivalent container to prevent the potential for cross contamination of the samples by water produced from melting ice. If ice is used, the coolers should be checked regularly and water should be drained as needed. Custody of samples will be maintained according to the SESD Operating Procedure for Sample and Evidence Management (SESDPROC-005).

Samples will either be transported to the analytical laboratory by field investigators or shipped by common carrier. Shipping of samples will be conducted in accordance with the SESD Operating Procedure for Packing, Marking, labeling, and Shipping of Environmental and Waste Samples (SESDPROC-209).

3 Quality Control Samples

Quality control samples are collected during field studies for various purposes, among which are to isolate site effects (control samples), to define background conditions (background sample), and to evaluate field/laboratory variability (spikes and blanks, trip blanks, duplicate, split samples, etc.).

3.1 Control Sample

A control sample is typically a discrete grab sample collected to isolate a source of contamination. Isolation of a source could require the collection of both an upstream sample at a location where the medium being studied is unaffected by the site being studied, as well as a downstream control which could be affected by contaminants contributed from the site under study.

3.2 Background Sample

A background sample (usually a grab sample) is collected from an area, water body, or site similar to the one being studied, but located in an area known or thought to be free from pollutants of concern.

3.3 Variability Samples

Variability may be defined as a variation in concentrations of compounds or analytes across a site or area of investigation or variations, across time, of waste streams or surface water bodies. Variation can also be introduced during sample handling. The following procedures are used to assess and evaluate variability. When appropriate, spatial duplicate grab and/or composite samples should be collected during investigations and studies in accordance to the project DQOs. In general, no more than ten percent of all samples should be collected as spatial duplicates.

3.3.1 Spatial Variability Duplicate

The following spatial duplicate sampling procedures should be used during the collection of samples as a measure of variability within the area represented by the sample. These samples should be collected at the same time, using the same procedures, the same type of equipment, and in the same types of containers as the original samples. They should also be preserved in the same manner and submitted for the same analyses as the required samples.

Spatial variability duplicate samples are typically collected during investigations where samples are collected from grids that are positioned at fixed intervals over the study area and a sample collection pattern is established within the grids. Spatial variability duplicate samples are collected using the same compositing pattern as the original sample and are collected within the same general area of representativeness, however the pattern is shifted relative to the original aliquot locations. This amount and direction of shift for the duplicate sample is dependent upon the size of the grid or area being sampled and should be specified in the QAPP for the investigation. Data from spatial duplicates will be examined by the investigation project leader to determine if the observed spatial variability is acceptable, based on the investigation or study objectives.

3.3.2 Temporal Variability Duplicate

When appropriate, temporal variability at a given sampling location will be measured by collecting temporal duplicate samples. These samples will be collected from the same sampling location, using the same techniques and the same type of equipment, but at a time different from the original sample. The time selected for the temporal duplicate sample will be similar to the time or span of time specified for the original sample in the project work plan. Data from temporal duplicates will be examined by the project leader to determine if samples represent the time span intended in the project work plan.

3.3.3 Sample Handling Variability

The effectiveness of sample handling techniques will be measured by collecting split and blank samples.

Split Samples

Split samples will be collected by initially collecting twice as much volume as is normally collected. The material will be apportioned, after mixing, if appropriate, into two sets of containers. Both sets of containers will be submitted for analyses with one set designated as an "original sample," the other designated as a "split sample." Data from the split samples will be examined by the project leader to assess sample handling variability. On large studies (more than 20 samples collected), a minimum of 5 percent, but no more than 10 percent, of all samples will be collected as split samples unless required by site data quality objectives.

Blank Samples

The following blank samples will be prepared by the laboratory and obtained by the project leader prior to traveling to a sample site.

1. Water Sample VOC Trip Blank - A water sample VOC trip blank is required for every study where water samples are collected for VOC analysis. Sealed preserved (or unpreserved, if unpreserved vials were used during the investigation) 40-ml VOC vials will be transported to the field. Two sealed VOC vials will be submitted per trip blank sample. At least one trip blank sample will be submitted per sample shipment. Trip blanks will be prepared by lab personnel. Investigators should submit their request for trip blanks at least one week in advance of scheduled field investigations and inspections and never (except in emergency situations) less than two days in advance of scheduled field investigations and inspections. These samples should not be picked up earlier than the morning of departure for the scheduled

inspection/investigation. These trip blanks will be handled and treated in the same manner as the water samples collected for volatile organic compounds analysis on that particular study. These samples will be clearly identified on sample labels and Chain-of-Custody Records as trip blanks.

2. Soil/Sediment Sample VOC Trip Blank - A soil/sediment sample VOC trip blank is required for every study where soil and/or sediment samples are collected for VOC analysis. The required containers are specified the USEPA Region 4 ASBLOQAM. The request and pick up of the soil blank sample will be the same as for the water trip blank. En Core® containers will be transported to the field. These blanks will be handled and treated by field investigators in the same manner as the soil samples collected for VOC analysis on that particular study. These samples will be clearly identified on sample labels and Chain-Of-Custody Records as trip blanks. Two sealed En Core® containers will be submitted per trip blank sample. At least one set of trip blank samples will be submitted per sample shipment.

The following blanks are prepared in the field:

1. Sample Preservative Blanks - Sample containers will be filled with de-ionized water by ASB personnel and transported to the field and preserved and submitted for the same analyses as the other inorganic samples collected. These samples will be clearly identified as preservatives blanks on sample labels and the Chain-Of-Custody Record(s). At least one preservative blank for each type of preserved sample should be collected at the end of routine field investigations. In addition, one preservative blank will be collected for each bottle of preservative used.

2. Equipment Rinsate Blanks - Equipment rinsate blanks will be collected whenever field decontamination of equipment to be re-used in sampling activities is performed.

   When field cleaning of equipment is required during a sampling investigation, a piece of the field-cleaned equipment will be selected for collection of a rinse blank. At least one rinse blank will be collected during each week of sampling operations. After the piece of equipment has been field cleaned and prior to its being used for sample operations, it will be rinsed with organic-free water. The rinse water will be collected and submitted for analyses of all constituents for which normal samples collected with that piece of equipment are being analyzed.

3. Organic-Free Water System Blanks - When using a portable organic-free water generating system in the field, a sample of the water generated by the system will be collected at least once during each week of operations. Based on the objectives of the study or investigation, it may be appropriate to collect a sample of the raw source water. The collected water sample will be submitted for analyses of all constituents for which normal samples are being analyzed.

4. Material Blanks - When construction materials are being used on a site in such a way as to have a potential impact on constituent concentrations in the sample, a sample of each material will be submitted for analysis.

   Note: For drilling operations where materials are shipped directly to the site from the supplier, see SESD Guidance for Design and Installation of Monitoring Wells (SESDGUID-101) for material blank collection and reporting requirements.

5. Automatic Sampler Blanks - In general, cleaning procedures outlined in the SESD Operating Procedure for Field Equipment Cleaning and Decontamination at the FEC (SESDPROC-206) should be adequate to ensure sample integrity. However, it is the standard practice of the Environmental Investigations Branch to submit automatic sampler blanks for analyses when automatic samplers are used to collect samples for organic compounds and metals analyses. Automatic sampler blanks for other standard analyses may be submitted in the event of a special investigation (e.g., criminal or civil).

6. Field Blank - A field blank is a sample that is prepared in the field to evaluate the potential for contamination of a sample by site contaminants from a source not associated with the sample collected (for example air-borne dust or organic vapors which could contaminate a soil sample). Organic-free water is taken to the field in sealed containers or generated on-site. The water is poured into the appropriate sample containers at pre-designated locations at the site. Field blanks should be collected in dusty environments and/or from areas where volatile organic contamination is present in the atmosphere and originating from a source other than the source being sampled.

7. Temperature Blank - A temperature blank is a container of water shipped with each cooler of samples requiring preservation by cooling to 6°C (ice). The temperature of the blank is measured at the time of sample receipt by the laboratory. No temperature blank is necessary for waste samples since waste samples do not require ice for preservation.

8. Wipe Sample Blank - A wipe sample blank is a sample of the material and solvent used for collecting wipe samples. The blank is handled, packaged, and transported in the same manner as all other wipe samples with the exception that it is not exposed to actual contact with the sample medium.

9. Filter Blank - When filters are used for sampling a dissolved constituent, de-ionized water should be run through at least one filter from each lot and the filtered water submitted for the same analyses. When filters are used for chlorophyll sampling, the filter should be prepared using de-ionized water and submitted for the same chlorophyll analysis.

3.4 Spikes

Spike samples are used to measure bias due to sample handling or analytical procedures. Spike samples are typically used by SESD to evaluate the performance of contract laboratories and are shipped directly to the CLP laboratory by the ESAT contractor.

3.5 Matrix Spike/Matrix Spike Duplicate Samples for Water and Soil Samples for Organic Compounds Analyses

Matrix spike and matrix spike duplicate (MS/MSD) samples will be submitted to the laboratory for volatile organic compounds, extractable organic compounds, pesticides/PCBs and/or herbicides analyses from at least one sampling location per project and laboratory used. One MS/MSD sample should be collected per 20 samples per media collected.

Additional volume will be required for the soil MS/MSD samples. Semi-volatile organic compounds, pesticides, and PCB analyses of soil/sediment samples require the collection of one additional eight ounce glass jar. For VOC soil/sediment samples, triple volume, i.e., nine En Cores® or nine 40 ml vials with syringe collected sample, is needed for the MS/MSD samples.

Additional volume will be required for the water MS/MSD samples. For routine full scan analysis, i.e., extractable organic compounds, pesticides and PCBs, four one-liter amber containers provide the required sample volume. Eight containers, therefore, should be submitted for the MS/MSD sample. For VOC water samples, a total of six 40-ml vials should be collected.

MS/MSD samples should be collected from a location expected to be relatively free from contamination, since the samples will be used for laboratory quality control purposes. The duplicate samples should be clearly identified as "Duplicate Sample for Matrix Spike" or “MS/MSD” on the Chain-Of-Custody Record, in the field logbook and on the Contract Laboratory Program (CLP) Traffic Report Form (if appropriate). This procedure will be followed for all projects where water samples are collected for the indicated analyses. For non-routine sampling events, the Region 4 SESD laboratory should be consulted for specific sample volume and container requirements.

3.6 Matrix Spike/Matrix Spike Duplicate Samples for Water and Soil Samples for Inorganic Analyses

A matrix spike sample and a duplicate sample (MS/MSD) will be submitted to the laboratory for inorganic analyses from at least one sampling location per project and laboratory used. One matrix spike and duplicate sample should be collected per 20 samples per media collected per laboratory.

Soil/sediment and water samples collected for inorganic analyses will normally have sufficient sample volume to perform the matrix spike analyses without requiring the collection of extra sample volume. The project leader should designate a sample, typically one considered to be representative of background or relatively uncontaminated conditions, as the matrix spike sample. For water samples, the sample volume collected will normally provide adequate volume for the MS/MSD analyses.

MS/MSD samples should be collected from a location expected to be relatively free from contamination, since the samples will be used for laboratory quality control purposes. MS/MSD samples should be clearly identified as "Duplicate Sample for Matrix Spike" or "MS/MSD" on the Chain-Of-Custody Record, in the field logbook and on the Contract Laboratory Program (CLP) Traffic Report Form (if appropriate). This procedure will be followed for all projects where water samples are collected for the indicated analyses. For non-routine sampling events, the Region 4 SESD laboratory should be consulted for specific sample volume and container requirements.

3.7 Special Quality Control Procedures for EPA Contract Laboratories

On a case-by-case basis, field investigators may be required to collect split samples (or duplicate samples if appropriate) for analyses by either the Region 4 SESD laboratory or contract laboratories. The split samples are to be submitted to the Region 4 laboratory using established procedures. The contract laboratory involved <u>will not be notified</u> that samples were split, i.e., there should be no indication on Chain-Of-Custody Records or CLP Traffic Report Forms submitted to the contract laboratories that these samples were split with the Region 4 SESD laboratory.

3.8 Special Quality Control Procedures for Dioxins and Furans

The Region 4 laboratory does <u>not</u> conduct in-house analyses for dioxins and furans. Dioxin and furans analyses are conducted by contract laboratories. The Region 4 laboratory may accept environmental samples (soil, sediment, groundwater, and surface water) suspected of being contaminated with polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF), as long as suspected PCDD and PCDF contamination is not due to RCRA hazardous waste classified as F020-023 and/or F026-028. If these environmental samples are not contaminated with an F020-023 and/or F026-028 waste, it may be analyzed for parameters other than dioxin and furans. Environmental samples known or suspected to be contaminated with the RCRA hazardous waste F020-023 and or F026-028 will not be accepted.

NOTE: Environmental samples suspected of being contaminated with RCRA hazardous waste classified in 40 CFR, 261.31 as F032 will be accepted. The F032 waste is defined as wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used chlorophenolic formulations. The F032 listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and or pentachlorophenol. Prior to a sampling event, the project leaders should consult with the Analytical Support Branch Sample Control Coordinator to determine if the Region 4 laboratory can accept the samples. The Region 4 SESD laboratory should also be consulted for the current quality control procedures for dioxins and furans samples prior to a sampling investigation.

4 Internal Quality Control Procedures

The focus of this section is on Field Equipment Center (FEC) operations involving preparation of sampling and support equipment for field operations, as well as, field data generated under the specific sample collection quality control procedures discussed in Section 2. Quality control checks of these operations ensure that field sampling teams are provided with equipment that is suitable for sampling use, and that field sampling is conducted using proper procedures.

4.1 Traceability Requirements

Records, in the form of bound notebooks, will be kept by FEC personnel documenting the dates of operations and the person performing operations for the following:

1. Organic-Free Water System Maintenance (Field and FEC Systems) - Maintenance on field systems will be performed at least once per 180 days. FEC system maintenance will be performed at least once per 180 days.

2. Air Monitoring Safety Instrumentation Checkouts - Pre-loadout checks on safety monitoring instrumentation will be recorded each time they are performed. Discrepancies will be immediately reported to the Branch Safety Officer.

3. Self Contained Breathing Apparatus (SCBA) Checkouts - Pre-loadout checks on SCBAs will be recorded when they are performed. SCBA checkouts will be performed at least once per calendar quarter in the absence of loadout requests. Any discrepancies will be reported immediately to the Branch Safety Officer.

4. Other Equipment Maintenance - Maintenance performed on equipment other than that listed above will be accordance to the SESD Operating Procedure for Equipment Inventory and Management (SESDPROC-108). All required repairs will be reported to appropriate Branch Field Equipment Manager.

5. Sampling Containers and Latex Gloves - The Enforcement and Investigations Branch Quality Assurance Officer (EIB QAO) is responsible for conducting verification sampling for sample containers and latex gloves that are used during field investigations. Upon receipt, the containers and gloves are placed in the quarantine room at the FEC. A record is kept of the lot numbers for each shipment received. The EIB QAO will collect blank samples from containers and gloves within each lot received and will review the results to ensure the sample containers and gloves are suitable for use during field investigations. Once the supplies are deemed suitable, the EIB QAO will release the items for use. All equipment cleaned and wrapped for field use will be marked with the date on which preparation was completed. Equipment will be stored at the FEC in specified areas to minimize the risk of contamination while awaiting use.

4.2 Specific Quality Control Checks

When collecting samples during field investigations, it is necessary to take measures to prevent cross contamination to ensure the integrity of the data generated. The field branches conduct verification sampling of sample containers, gloves, sampling equipment, tubing and water utilized during field investigations as one of these measures. At least once per calendar quarter, the EIB QAO will conduct the following checks and issue a written report to the EIB Branch Chief and Field Quality Manager with the results.

1. Collect and submit for analyses samples of each new lot of containers and Teflon tubing received during that quarter. Rinse blanks will be collected through the Teflon tubing. Bottles from each lot will be tagged and sealed, then submitted for the following analyses:

    1. 1-liter Amber – extractable organics, pesticides, and PCBs.

    2. 8-oz. Clear Glass – metals, cyanide, extractable organics, pesticides, PCBs, and volatile organic compounds.

    3. 1-Liter Polyethylene – metals and cyanide.

    4. Teflon tubing – metals, cyanide, extractable organics, volatile organic compounds, pesticides, and PCBs.

    NOTE: In addition to the quality control checks listed above, samples may be collected during field investigations for classical inorganic parameters such as nitrates, nitrites, sulfides, etc. Due to the detection levels generally required for these parameters, it is unlikely that cross contamination may occur in association with the sample containers and sampling equipment used during sample collection. Therefore, classical inorganic analyses are not conducted as part of the routine quality control checks. If the data quality objectives require additional quality control checks, bottles will be submitted to the laboratory for analyses.

2. Collect and submit for analyses a rinsate blank for each new lot of latex gloves received during the calendar quarter. Samples will be collected as rinse blanks using organic-free water. The rinsate will be submitted for analyses of VOCs, metals, cyanide, extractable organics, pesticides, and PCBs. A new glove will be rinsed for each parameter (e.g., one glove for the VOC sample, another glove for metals, etc.) to avoid dilution of potential contaminants on the gloves.

3. Collect and submit for analyses a sample of water from the FEC organic-free water system. The sample will be submitted for analyses of VOCs, metals, cyanide, extractable organics, pesticides, and PCBs.

4. Collect and submit for analyses a rinsate blank of at least one piece of sampling or sample related equipment stored at the FEC. The sample will submitted for analyses of VOCs, metals, cyanide, extractable organics, pesticides, and PCBs.

5. Collect and submit for analyses a rinsate blank for each new lot of Silastic® or Tygon® tubing used in peristaltic pump head. The sample will be submitted for metals and cyanide analysis.

4.3 Quality Control for Special Order Equipment and Supplies

Some equipment and supplies ordered for specific projects are received in what can be considered ready to use condition. In order to ensure the integrity of these materials, an equipment rinsate blank will be collected from at least one item in each lot. The equipment and supplies will not be used until the QAO has reviewed the analytical data for the blanks and released the items.

4.4 Quality Control Evaluation and Corrective Action

All field investigation reports will contain a clearly identified section where the results for all field generated quality control (QC) samples are discussed and reported. Quality control data review includes but is not limited to detections of organic and inorganic compounds at any concentration in quality control blanks (i.e., trip blanks, equipment rinsate blanks, portable organic-free water system blanks, etc.).

All detections of organic and inorganic compounds will be immediately reported to the appropriate branch QAO. The project leader will analyze of the results to determine if the source of contamination can be identified. If the source of contamination cannot be determined by the project leader, the branch QAO will conduct an additional review of the results to assess the source of contamination. If the source of contamination cannot be determined, the branch QAO will monitor all quality control results generated by the branch and assess the data for trends of contamination.

If it is determined by the project leader and the branch QAO that the contamination adversely impacts the data collected during the investigation, the project leader will report the results to their Section Chief and the FQM. The project leader, in consultation with management, will determine whether the impacted data are usable or should be rejected. If data are rejected, the project leader and their management will determine whether samples must be recollected.

Data reported to the FQM will be analyzed to determine if the contamination is due to non-conforming work. If it is determined by the FQM, in consultation with management, that the contamination is due to non-conforming work, a corrective action is warranted and will be selected and implemented in a timely manner. If a corrective action is required, it must be implemented and reported according to the SESD Operating Procedure for Corrective Action (SESDPROC-009). If contamination is not due to non-conforming field work, then the source of contamination will be identified, if possible, and documented by the FQM. If the source of contamination cannot be determined, FQM will monitor all quality control results generated by SESD and assess the data for trends of contamination.

4.4.1 Quality Assurance Reports

It is each project leader's responsibility to ensure that a copy of the quality assurance data from each field investigation report is provided to their respective branch QAO. Each branch QAO will prepare a compilation of the quality assurance field data sections from each report and forward this report to the FQM. Due to the differences in number and nature of sampling investigations conducted, the EIB QA manager will compile a quarterly report of field quality assurance data and the EAB QA manager will compile an annual report.

The FQM will prepare an annual quality assurance report based on the reports provided by the branch QAOs. This report will be distributed to all field investigators each year and will document and discuss all quality control issues or trends identified during the data review. This report will be retained by the FQM to document that QC measures have been taken, that the QC measures are appropriate, that the QC results are acceptable or, if not, that corrective actions were taken.

APPENDIX E

Quality Assurance Project Plan (QAPP)/USEPA Authorization

EPA United States of America Environmental Protection Agency

A FAX FROM:

TO: Michele Christina	**FAX NO.:** (732) 782-0404
SUBJECT: QAPP Forms	
FROM: Alison Devine	**PHONE NO.:** (212) 637-4158
OFFICE: Brownfields	**FAX NO. FOR:**
COMMENTS: Here they are.	
DATE and TIME: 10/25/11 1:19 pm	**NO. of PAGES:** 4

EPA Form 1315-18 (Rev. 5/97) (WebForms v1.0)

Brownfields Hazardous Substances Cleanup Grant
City of Camden Redevelopment Agency, Camden, NJ

The attached U.S. EPA Region 2 Generic Brownfields Quality Assurance Project Plan (QAPP) boilerplate has been submitted in compliance with the provisions of the City of Camden Redevelopment Agency Brownfields Hazardous Substances Cleanup Grant, **ABC Barrel Project 121-123 Penn Street Site**, Cooperative Agreement No. BF 97216211.

The undersigned agrees to use this Generic Brownfields QAPP boilerplate to prepare site-specific Sampling, Analysis, and Monitoring Plans (SAMPs) for remedial projects funded under the U.S. EPA Region 2 Brownfields Economic Re-development Initiative. The undersigned also agrees to incorporate any comments provided by the governing state environmental regulatory authority (NJDEP) concerning the development of site-specific SAMPs.

Municipal Brownfields Project Manager Concurrence:

James Harveson ________________ *Signature*

James Harveson, Director of Economic Development ________________ *Printed Name/Date*

U.S. EPA Region 2 Project Manager Approval:

________________ 05/11/2011 ________________ *Signature*

Alison Devine ________________ *Printed Name/Date*

Brownfields Hazardous Substances Cleanup Grant
City of Camden Redevelopment Agency, Camden, NJ

The attached U.S. EPA Region 2 Generic Brownfields Quality Assurance Project Plan (QAPP) boilerplate has been submitted in compliance with the provisions of the City of Camden Redevelopment Agency Brownfields Hazardous Substances Cleanup Grant, **ABC Barrel Project 324-330 North Front Street Site**, Cooperative Agreement No. BF 97216411.

The undersigned agrees to use this Generic Brownfields QAPP boilerplate to prepare site-specific Sampling, Analysis, and Monitoring Plans (SAMPs) for remedial projects funded under the U.S. EPA Region 2 Brownfields Economic Re-development Initiative. The undersigned also agrees to incorporate any comments provided by the governing state environmental regulatory authority (NJDEP) concerning the development of site-specific SAMPs.

Municipal Brownfields Project Manager Concurrence:

James Harveson ______________________ *Signature*

James Harveson, Director of Economic Development ______________________ *Printed Name/Date*

U.S. EPA Region 2 Project Manager Approval:

05/11/2011 ______________________ *Signature*

Alison Devine ______________________ *Printed Name/Date*

Brownfields Hazardous Substances Cleanup Grant
City of Camden Redevelopment Agency, Camden, NJ

The attached U.S. EPA Region 2 Generic Brownfields Quality Assurance Project Plan (QAPP) boilerplate has been submitted in compliance with the provisions of the City of Camden Redevelopment Agency Brownfields Hazardous Substances Cleanup Grant, **ABC Barrel Project 300 Block of North 2nd Street Site**, Cooperative Agreement No. BF 97216311.

The undersigned agrees to use this Generic Brownfields QAPP boilerplate to prepare site-specific Sampling, Analysis, and Monitoring Plans (SAMPs) for remedial projects funded under the U.S. EPA Region 2 Brownfields Economic Re-development Initiative. The undersigned also agrees to incorporate any comments provided by the governing state environmental regulatory authority (NJDEP) concerning the development of site-specific SAMPs.

Municipal Brownfields Project Manager Concurrence:

James Harveson _______________ *Signature*

James Harveson, Director of Economic Development _______________ *Printed Name/Date*

U.S. EPA Region 2 Project Manager Approval:

_______________ 05/11/2011 _______________ *Signature*

Alison Devine _______________ *Printed Name/Date*

APPENDIX F
Draft Deed Notice

Draft Deed Notice
Camden Redevelopment Agency
ABC Barrel Company Site
Block 62 Lots 38 & 45
City of Camden, Camden County, New Jersey

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Draft Deed Notice
Camden Redevelopment Agency
ABC Barrel Company Site
Block 62 Lots 38 & 45
City of Camden, Camden County, New Jersey

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   - ii. A-2: Scaled Metes and Bounds Description of Property
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C. ATTACHMENTS (TO BE PROVIDED WITH FINAL DEED NOTICE)

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Attachment 2: Biennial Certification Monitoring Report Form

DEED NOTICE

IN ACCORDANCE WITH N.J.S.A. 58:10B-13, THIS DOCUMENT IS TO BE RECORDED IN THE SAME MANNER AS ARE DEEDS AND OTHER INTERESTS IN REAL PROPERTY.

Prepared by:
DRESDNER ROBIN FOR CAMDEN REDEVELOPMENT AGENCY

____
[Signature]

____
[Print Name Below Signature]

Recorded by:

____
[Signature, Officer of County Recording Office]

____
[Print Name Below Signature]

DEED NOTICE

This Deed Notice is made as of the _____ day of _____________, by the Camden Redevelopment Agency, City Hall, Suite 1300, P.O. Box 95120, Camden, New Jersey, 08101 (together with his/her/its/their successors and assigns, collectively "Owner").

1. THE PROPERTY. Camden Redevelopment Agency, City Hall, Suite 1300, P.O. Box 95120, Camden, New Jersey, 08101 is the owner in fee simple of certain real property designated as the ABC Barrel Company Site located at 308 to 322 North Front Street, Block 62 Lots 38 & 42 on the tax map of the City of Camden, Camden County, New Jersey; the New Jersey Department of Environmental Protection Program Interest Number (Preferred ID) for the contaminated site is 006594; and the property is more particularly described in Exhibit A, which is attached hereto and made a part hereof (the "Property").

2. DEPARTMENT'S ASSIGNED BUREAU. The Bureau of Southern Field Operations, was the New Jersey Department of Environmental Protection program that was responsible for the oversight of the remediation of the Property.

3. SOIL CONTAMINATION. Soil contamination remains in certain areas of the Property which contains contaminants in concentrations that do not allow for the unrestricted use of the Property; this soil contamination is described, including the type, concentration and specific location of such contaminants, in Exhibit B, which is attached hereto and made a part hereof. As a result, there is a statutory requirement for this Deed Notice and engineering controls in accordance with N.J.S.A. 58:10B-13.

4. CONSIDERATION. In accordance with NJDEP approval of the remedial action, and other good and valuable consideration, Owner has agreed to subject the Property to certain statutory and regulatory requirements which impose restrictions upon the use of the Property, to restrict certain uses of the Property, and to provide notice to subsequent owners, lessees and operators of the restrictions and the monitoring, maintenance, and biennial certification requirements outlined in this Deed Notice and required by law, as set forth herein.

5A. RESTRICTED AREAS. Due to the presence of contaminants, the Owner has agreed, as part of the remedial action for the Property, to restrict the use of certain parts of the Property (the "Restricted Areas"); a narrative description of these restrictions, along with the associated monitoring and maintenance activities and the biennial certification requirements are provided in Exhibit C, which is attached hereto and made a part hereof. The Owner has also agreed to maintain a list of these restrictions on site for inspection by governmental enforcement officials.

5B. ENGINEERING CONTROLS. Due to the presence and concentration of these contaminants, the Owner has also agreed, as part of the remedial action for the Property, to the placement of certain engineering controls on the Property; a narrative description of these engineering controls, along with the associated monitoring and maintenance activities and the biennial certification requirements are provided in Exhibit C.

6A. ALTERATIONS, IMPROVEMENTS, AND DISTURBANCES.

i. Except as provided in Paragraph 6B, below, no person shall make, or allow to be made, any alteration, improvement, or disturbance in, to, or about the Property which disturbs any engineering control at the Property without first obtaining the express written consent of the Department of Environmental Protection. Nothing herein shall constitute a waiver of the obligation of any person to comply with all applicable laws and regulations including, without limitation, the applicable rules of the Occupational Safety and Health Administration. To request the consent of the Department of Environmental Protection, contact:

Department of Environmental Protection
Division of Remediation Management and Response
Bureau of Operation, Maintenance, and Monitoring
Deed Notice Inspection Program
P.O. Box 413
401 E. State Street
Trenton, NJ 08625-0413

ii. Notwithstanding subparagraph 6A.i., above, the Department of Environmental Protection's express written consent is not required for any alteration, improvement, or disturbance provided that the owner, lessee or operator:

(A) Notifies the Department of Environmental Protection of the activity by calling the DEP Hotline, at 1-877-WARN-DEP or 1-877-927-6337, within twenty-four (24) hours after the beginning of each alteration, improvement, or disturbance;

(B) Restores any disturbance of an engineering control to pre-disturbance conditions within sixty (60) calendar days after the initiation of the alteration, improvement or disturbance;

(C) Ensures that all applicable worker health and safety laws and regulations are followed during the alteration, improvement, or disturbance, and during the restoration;

(D) Ensures that exposure to contamination in excess of the applicable remediation standards does not occur;

(E) Submits a written report, describing the alteration, improvement, or disturbance, to the Department of Environmental Protection within sixty calendar days after the end of each alteration, improvement, or disturbance. The owner, lessee or operator shall include in the report the nature of the alteration, improvement, or disturbance, the dates and duration of the alteration, improvement, or disturbance, the name of key individuals and their affiliations conducting the alteration, improvement, or disturbance, a description of the notice the Owner gave to those persons prior to the disturbance, the amounts of soil generated for disposal, if any, the final disposition and any precautions taken to prevent exposure. The owner, lessee, or operator shall submit the report to:

Department of Environmental Protection
Division of Remediation Management and Response
Bureau of Operation, Maintenance, and Monitoring
Deed Notice Inspection Program
P.O. Box 413
401 E. State Street
Trenton, NJ 08625-0413

6B. EMERGENCIES. In the event of an emergency, which presents, or may present, an unacceptable risk to the public health and safety, or to the environment, any person may temporarily breach any engineering control provided that that person complies with each of the following:

i. Immediately notifies the Department of Environmental Protection of the emergency, by calling the DEP Hotline at 1-877-WARNDEP or 1-877-927-6337;

ii. Limits both the actual disturbance and the time needed for the disturbance to the minimum reasonably necessary to adequately respond to the emergency;

iii. Implements all measures necessary to limit actual or potential, present or future risk of exposure to humans or the environment to the contamination;

iv. Notifies the Department of Environmental Protection when the emergency has ended by calling the DEP Hotline at 1-877-WARNDEP or 1-877-927-6337;

v. Restores the engineering control to the pre-emergency conditions as soon as possible, and provides a written report to the Department of Environmental Protection of such emergency and restoration efforts within sixty calendar days after completion of the restoration of the engineering control. The report must include all information pertinent to the emergency, potential discharges of contaminants, and restoration measures that were implemented, which, at a minimum, should specify: (a) the nature and likely cause of the emergency, (b) the potential discharges of or exposures to contaminants, if any, that may have occurred, (c) the measures that have been taken to mitigate the effects of the emergency on human health and the environment, (d) the measures completed or implemented to restore the engineering control, and (e) the changes to the engineering control or site operation and maintenance plan to prevent recurrence of such conditions in the future. The owner, lessee, or operator shall submit the report to:

Department of Environmental Protection
Division of Remediation Management and Response
Bureau of Operation, Maintenance, and Monitoring
Deed Notice Inspection Program
P.O. Box 413
401 E. State Street
Trenton, NJ 08625-0413

7A. MONITORING AND MAINTENANCE OF DEED NOTICE, AND PROTECTIVENESS CERTIFICATION. The persons in any way responsible, pursuant to the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11a et seq., for the hazardous substances that remain at the Property, the persons responsible for conducting the remediation, the Owner, and the subsequent owners, lessees, and operators, shall monitor and maintain this Deed Notice, and certify to the Department on a biennial basis that the remedial action that includes this Deed Notice remains protective of the public health and safety and of the environment. The subsequent owners, lessees and operators have this obligation only during their ownership, tenancy, or operation. The specific obligations to monitor and maintain the deed notice shall include all of the following:

i. Monitoring and maintaining this Deed Notice according to the requirements in Exhibit C, to ensure that the remedial action that includes the Deed Notice continues to be protective of the public health and safety and of the environment;

ii. Conducting any additional remedial investigations and implement any additional remedial actions, that are necessary to correct, mitigate, or abate each problem related to the protectiveness of the remedial action for the property prior to the date that the certification is due to the Department pursuant to iii, below, in order to ensure that the remedial action that includes this Deed Notice remains protective of the public health and safety and of the environment.

iii. Certify to the Department of Environmental Protection as to the continued protectiveness of the remedial action that includes this Deed Notice, on a form provided by the Department and consistent with N.J.A.C. 7:26C-1.2 (a)1, every two years on the anniversary of the date the Department issued the no further action letter for the first soil remedial action that included a Deed Notice.

7B. MONITORING AND MAINTENANCE OF ENGINEERING CONTROLS, AND PROTECTIVENESS CERTIFICATION. The persons in any way responsible, pursuant to the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11a et seq., for the hazardous substances that remain at the Property, the person responsible for conducting the remediation, and, the Owner, and the subsequent owners, lessees, and operators, shall maintain all engineering controls at the Property and certify to the Department on a biennial basis that the remedial action of which each engineering control is a part remains protective of the public health and safety and of the environment. The subsequent owners, lessees and operators have this obligation only during their ownership, tenancy, or operation. The specific obligations to monitor and maintain the engineering controls shall include the following:

i. Monitoring and maintaining each engineering control according to the requirements in Exhibit C, to ensure that the remedial action that includes the engineering control continues to be protective of the public health and safety and of the environment;

ii. Conducting any additional remedial investigations and implement any additional remedial actions, that are necessary to correct, mitigate, or abate each problem related to the protectiveness of the remedial action for the property prior to the date that the certification is due to the Department pursuant to iii, below, in order to ensure that the remedial action that includes the engineering control remains protective of the public health and safety and of the environment.

iii. Certify to the Department of Environmental Protection as to the continued protectiveness of the remedial action that includes the engineering control, on a form provided by the Department and consistent with N.J.A.C. 7:26C-1.2 (a)1, every two years on the anniversary of the date the Department issued the no further action letter for the first soil remedial action that included a Deed Notice.

8. ACCESS. The Owner and the subsequent owners, lessees and operators agree to allow the Department, its agents and representatives access to the Property to inspect and evaluate the continued protectiveness of the remedial action that includes this Deed Notice and to conduct additional remediation to ensure the protection of the public health and safety and of the environment if persons responsible for monitoring the protectiveness of the remedial action, as described in Paragraph 7, above, fail to conduct such remediation pursuant to this Deed Notice as required by law. The Owner, and the subsequent owners and lessees, shall also cause all leases, subleases, grants, and other written transfers of an interest in the Restricted Areas to contain a provision expressly requiring that all holders thereof provide such access to the Department.

9. NOTICES.

i. The Owner and the subsequent owners and lessees, shall cause all leases, grants, and other written transfers of an interest in the Restricted Areas to contain a provision expressly requiring all holders thereof to take the Property subject to the restrictions contained herein and to comply with all, and not to violate any of the conditions of this Deed Notice. Nothing contained in this Paragraph shall be construed as limiting any obligation of any person to provide any notice required by any law, regulation, or order of any governmental authority.

ii. Owner and all subsequent owners and lessees shall notify any person intending to conduct invasive work or excavate within the Restricted Areas at the Property, including, without limitation, tenants, employees of tenants, and contractors of the nature and location of contamination in the Restricted Areas, and, of the precautions necessary to minimize potential human exposure to contaminants.

iii. The Owner and the subsequent owners shall provide written notice to the Department of Environmental Protection at least thirty calendar days before the effective date of any conveyance, grant, gift, or other transfer, in whole or in part, of the owner's interest in the Restricted Area.

iv. The Owner and the subsequent owners shall provide written notice to the Department within thirty (30) calendar days following the owner's petition for or filing of any document initiating a rezoning of the Property. The Owner and the subsequent owners shall submit the written notice to:

Department of Environmental Protection
Division of Remediation Management and Response
Bureau of Operation, Maintenance, and Monitoring
Deed Notice Inspection Program
P.O. Box 413
401 E. State Street
Trenton, NJ 08625-0413.

10. ENFORCEMENT OF VIOLATIONS.

i. This Deed Notice itself is not intended to create any interest in real estate in favor of the Department of Environmental Protection, nor to create a lien against the Property, but merely is intended to provide notice of certain conditions and restrictions on the Property and to reflect the regulatory and statutory obligations imposed as a conditional remedial action for this site.

ii. The restrictions provided herein may be enforceable solely by the Department against any person who violates this Deed Notice. To enforce violations of this Deed Notice, the Department may initiate one or more enforcement actions pursuant to N.J.S.A. 58:10-23.11u and require additional remediation and assess damages pursuant to N.J.S.A. 58:10-23.11g.

11. SEVERABILITY. If any court of competent jurisdiction determines that any provision of this Deed Notice requires modification, such provision shall be deemed to have been modified automatically to conform to such requirements. If a court of competent jurisdiction determines that any provision of this Deed Notice is invalid or unenforceable and the provision is of such a nature that it cannot be modified, the provision shall be deemed deleted from this instrument as though the provision had never been included herein. In either case, the remaining provisions of this Deed Notice shall remain in full force and effect.

12. SUCCESSORS AND ASSIGNS. This Deed Notice shall be binding upon Owner and upon Owner's successors and assigns, and subsequent owners, lessees and operators while each is an owner, lessee, or operator of the Property.

13. MODIFICATION AND TERMINATION.

i. Any person may request in writing, at any time, that the Department modify this Deed Notice where performance of subsequent remedial actions, a change of conditions at the Property, or the adoption of revised remediation standards suggest that modification of the Deed Notice would be appropriate.

ii. Any person may request in writing, at any time, that the Department terminate this Deed Notice because the conditions which triggered the need for this Deed Notice are no longer applicable.

iii. This Deed Notice may be revised or terminated only upon filing of an instrument, executed by the Department, in the office of the County Registrar of Bergen County, New Jersey, expressly modifying or terminating this Deed Notice.

14A. EXHIBIT A. Exhibit A includes the following maps of the Property and the vicinity:

i. Exhibit A-1: Vicinity Map - A map that identifies by name the roads, and other important geographical features in the vicinity of the Property (for example, Hagstrom County Maps);

ii. Exhibit A-2: Metes and Bounds Description - A metes and bounds description of the Property, including reference to tax lot and block numbers for the Property;

iii. Exhibit A-3: Property Map - A scaled map of the Property, scaled at one inch to 200 feet or less, and if more than one map is submitted, the maps shall be presented as overlays, keyed to a base map; and the Property Map shall include diagrams of major surface topographical features such as buildings, roads, and parking lots.

14B. EXHIBIT B. Exhibit B includes the following descriptions of the Restricted Areas:

i. Exhibit B-1: Restricted Areas (Exhibit B-1a) shows the location of three restricted areas within Property. Each restricted area maps includes:

(A) As-built diagrams of each engineering control, including caps, fences, slurry walls, ground water monitoring wells, and ground water pumping systems;

(B) As-built diagrams of any buildings, roads, parking lots and other structures that function as engineering controls; and

(C) Designation of all soil and sediment sample locations within the restricted areas that exceed any soil or sediment standard that are keyed into one of the tables described in the following paragraph.

ii. Exhibit B-2: Restricted Area Data Table - A separate table for each restricted area Exhibit B-2) that includes:

(A) Sample location designation from the Restricted Areas;

(B) Sample elevation based upon mean sea level;

(C) Name and chemical abstract service registry number of each contaminant with a concentration that exceeds the unrestricted use standard;

(D) The restricted and unrestricted use standards for each contaminant in the table; and

(E) The remaining concentration of each contaminant at each sample location at each elevation.

14C. EXHIBIT C. Exhibit C includes narrative descriptions of the institutional controls and engineering controls as follows:

i. Exhibit C-1: Deed Notice as Institutional Control: Exhibit C-1 includes a narrative description of the restriction and obligations of this Deed Notice that are in addition to those describe above, as follows:

(A) General Description of this Deed Notice:

(1) Description and estimated size of the Restricted Areas as described above;

(2) Description of the restrictions on the Property by operation of this Deed Notice; and

(3) The objective of the restrictions.

(B) Description of the monitoring necessary to determine whether:

(1) Any disturbances of the soil in the Restricted Areas did not result in the unacceptable exposure to the soil contamination;

(2) There have been any land use changes subsequent to the filing of this Deed Notice or the most recent biennial certification, whichever is more recent;

(3) The current land use on the Property is consistent with the restrictions in this Deed Notice;

(4) Any newly promulgated or modified requirements of applicable regulations or laws apply to the site; and

(5) Any new standards, regulations, or laws apply to the site that might necessitate additional sampling in order to evaluate the protectiveness of the remedial action which includes this Deed Notice, and conduct the necessary sampling.

(C) Description of the following items that will be included in the biennial certification:

(1) A monitoring report that describes the specific activities, pursuant to (A) and (B), above, conducted in support of the biennial certification of the protectiveness of the remedial action that includes this Deed Notice;

(2) Land use at the Property is consistent with the restrictions in this Deed Notice; and

(3) The remedial action that includes this Deed Notice continues to be protective of the public health and safety and of the environment.

ii. Exhibit C-2 and C-3: Details of Engineering Control Exhibit includes a narrative description of the asphalt pavement and landscape/soil cap as engineering control:

(A) General Description of the engineering control:

(1) Description of the engineering control;

(2) The objective of the engineering control; and

(3) How the engineering control is intended to function.

(B) Description of the operation and maintenance necessary to ensure that:

(1) Periodic inspections of each engineering control are performed in order to determine its integrity, operability, and effectiveness;

(2) Each engineering control continues as designed and intended to protect the public health and safety and the environment;

(3) Each alteration, excavation or disturbance of any engineering control is timely and appropriately addressed to maintain the integrity of the engineering control;

(4) This engineering control is being inspected and maintained and its integrity remains so that the remedial action continues to be protective of the public health and safety and of the environment;

(5) A record of the self-inspection dates, name of the inspector, results of the inspection and condition(s) of this engineering control. Sampling, for example, may be necessary if it is not possible to visually evaluate the integrity/ performance of this engineering control; and

(6) Any new standards, regulations, or laws apply to the site that might necessitate additional sampling in order to evaluate the protectiveness of the remedial action which includes this Deed Notice, and conduct the necessary sampling; and

(C) Description of the following items that will be included in the biennial certification:

(1) A monitoring report that describes the specific activities, pursuant to (A) and (B), above, conducted in support of the biennial certification of the protectiveness of the remedial action that includes this Deed Notice.

(2) The engineering controls continues to operate as designed; and

(3) The remedial action that includes the engineering control continues to be protective of the public health and safety and of the environment.

15. SIGNATURES. IN WITNESS WHEREOF, Owner has executed this Deed Notice as of the date first written above.

ATTEST: Camden Redevelopment Agency

___________________________ By_________________________

___________________________ ___________________________
[Print name and title] [Signature]

STATE OF NEW JERSEY
SS: COUNTY OF BERGEN

I certify that on _________________, 20__, [Name of person executing document on behalf of Owner] personally came before me, and this person acknowledged under oath, to my satisfaction, that:

(a) this person is the [secretary/assistant secretary] of the New Jersey Department of Transportation, the corporation named in this document;

(b) this person is the attesting witness to the signing of this document by the proper corporate officer who is the [president/vice president] of the corporation;

(c) this document was signed and delivered by the corporation as its voluntary act and was duly authorized;

(d) this person knows the proper seal of the corporation which was affixed to this document; and

(e) this person signed this proof to attest to the truth of these facts.

____
[Signature]

____
[Print name and title of attesting witness]

Signed and sworn before me on _________, 20__

____________________________________, Notary Public

____
[Print name and title]

EXHIBIT A

(TO BE INCLUDED WITH FINAL DRAFT)

EXHIBIT B

(TO BE INCLUDED WITH FINAL DRAFT)

EXHIBIT C

(TO BE INCLUDED WITH FINAL DRAFT)

APPENDICES

(TO BE INCLUDED WITH FINAL DRAFT)

APPENDIX G
Schedule

TO BE PROVIDED BY CONTRACTOR AFTER CONTRACT IS AWARDED